SHIPPING, ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA.

The Engineer.

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VOL. CLII.—No. 3949] LONDON: FRIDAY EVENING, SEPTEMBER 18, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 6th October, 1931, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at "Wordsworth" Telephone Exchange, Kenton, Middlesex.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7522

Chelsea Polytechnic,
MANRESA ROAD, CHELSEA, S.W. 3.

SPECIAL COURSES IN ENGINEERING METALLURGY

In addition to the Courses in General Metallurgy, arrangements have been made for Special Courses of Lectures and Practical Work:—

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FULL-TIME DAY DIPLOMA COURSES leading to professional recognition.
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Northampton Polytechnic INSTITUTE,
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An Examination will be held on September 24th and 25th at the Polytechnic for the award of the following Scholarships:—

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These Scholarships are tenable at courses extending over four years in Civil, Mechanical, Electrical or Aeronautical Engineering, and including ten months' practical experience in the works of large industrial firms.

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Hull Education Committee.
MUNICIPAL TECHNICAL COLLEGE.

AMENDED ADVERTISEMENT.

HEAD of ENGINEERING DEPARTMENT REQUIRED. Candidates should possess a Degree in Engineering and have had works training and teaching experience.

Salary £600 per annum, rising to £700 by £20 per annum.

Consultative work may be undertaken with the approval of the City Council.

Forms of application and further particulars may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope and must be returned so as to reach these offices not later than Saturday, the 26th September.

R. C. MOORE,
Director of Education.
Education Offices, Guildhall, Hull,
7th September, 1931. 7489

The Manchester Steam Users' ASSOCIATION.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.
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The Engineer

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ADMINISTRATIVE COUNTY OF LONDON.

School of Engineering and Navigation.

HIGH STREET, POPLAR, E. 14.

MECHANICAL ENGINEERING DEPARTMENT.

Major courses in mechanical, marine and civil engineering, and minor courses in mechanical engineering will commence on

MONDAY, 28TH SEPTEMBER, 1931.

(ENROLMENT during week commencing 21st September, 1931.)

The major courses are "recognised" for the National Certificates in mechanical engineering, both senior and advanced.

Courses are provided for the examinations for A.M.I. Mech. E. and A.M.I.C.E., and for those wishing to join the Royal Navy and Royal Air Force.

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MONTAGU H. COX,
Clerk of the London County Council.
7492

PUBLIC NOTICES.

County Borough of Wolverhampton.

BARNHURST SEWAGE PURIFICATION WORKS. CONTRACT NO. 8.

TO MAKERS OF PUMPS AND ELECTRIC MOTORS.

The Corporation is prepared to receive TENDERS for the SUPPLY of FOUR SETS of SLUDGE PUMPS of the Treble-ram or Two-barrel Double-acting Type driven by Electric Motors. Also for ONE CENTRIFUGAL PUMP driven by an Electric Motor for pumping sewage which has received tank treatment.

Each sludge pump will be required to discharge 230 gallons of sludge per minute. The centrifugal pump will be required to discharge about 1000 gallons of sewage per minute.

Tenderers will be required to submit prices for manufacture, delivery and installation of the required plant, piping, switchgear and other details. Two sludge pumps and the sewage pump are to be installed in one pumping station and the other two sludge pumps in a second pumping station.

On and after the 14th September, 1931, general conditions, specifications, schedules, bill of quantities and form of Tender may be obtained from the Engineers, Messrs. Dodd and Watson, MM. Inst. C.E., Wellington House, Bennetts Hill, Birmingham, on payment of a deposit of £2, which will be returned only on receipt of a bona fide Tender and the return of all documents.

A plan showing the constructional details of the pumping stations, a diagram of the connections required, and the pipe line to which the pumps are to be connected will be forwarded with the specification by the Engineers. Two other drawings showing tentative lay-outs of the piping in the two stations may be inspected at the Engineers' offices in Birmingham.

Sealed Tenders, addressed "J. Brock Allon, Esq., Town Clerk, Wolverhampton," and endorsed "Tender for Contract No. 8," should be delivered at this office before Noon on Tuesday, October 13th, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

J. BROCK ALLON,
Town Clerk.
Town Hall, Wolverhampton. 7498

SITUATIONS OPEN.

WANTED, for General Constructional Works in the Midlands, an experienced WORKS SUPERVISOR.—Address, with full particulars, giving experience and wages required, 7534, The Engineer Office. 7534 A

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DAVY BROTHERS, Limited, Park Ironworks, Sheffield, REQUIRE the SERVICES of a WORKS MANAGER with organising ability, between 30 and 40 years of age, to Take Control of their Engineering Shop and Ironfoundry at their new Darnall Works, Sheffield.—Apply in confidence to the CHAIRMAN at above address. 7532 A

GOVERNMENT OF NORTHERN IRELAND. CIVIL ENGINEERING APPOINTMENT.

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QUALIFICATIONS.—Candidates must hold a University Degree in Engineering or, alternatively, be corporate members of the Institution of Civil Engineers.

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PLANNING, RATE FIXING.—REQUIRED by Commercial Vehicle Manufacturer, ONE PLANNER and ONE RATE FIXER. Applicants must be thoroughly conversant with the latest machining practice as applied to medium and small quantities. Experience in keen accurate detailed work essential, particularly on Capstan and Turret Work.—Address, giving full details of experience, qualifications and salary required, 7536, The Engineer Office. 7536 A

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To be published on Monday

SEPTEMBER 21

The Times FARADAY NUMBER

TO mark the Centenary of one of the greatest of all scientific discoveries The Times will publish this Special Number to which some of the world's most distinguished philosophers, scientists and electrical experts will contribute. Among the many profoundly interesting articles which will appear will be :—

Faraday and the Production of Electricity from Magnetism	**Sir William Bragg, O.M., F.R.S.**
The Link between Faraday and Maxwell	**Sir J. J. Thomson, O.M., F.R.S.**
Faraday as an Experimenter	**Lord Rutherford, O.M., F.R.S.**
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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
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P1370 I

PATENTS

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THE PROPRIETOR of BRITISH PATENT No. 272,750, dated October 25, 1926, relating to "Improvements in the Method of and Apparatus for Finishing Cylindrical Bearing Surfaces," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Inquiries to B. SINGER, Steger Building, Chicago, Illinois. 7495 H

THE PROPRIETOR of BRITISH PATENTS No. 248,075, dated November 27, 1924, relating to "Improvements in a Paper Cup Forming Machine with Stacking Attachment;" 246,602, dated November 13, 1924, relating to "Improvements in a Cup Blank Punching Machine;" and 241,400, dated November 13, 1924, relating to "Improvements in and relating to the Counting Mechanism of Machines for Forming Paper Cups and like Containers," DESIRES to ARRANGE by LICENCE or otherwise on reasonable terms to EXPLOIT the above patents and ensure their practical working in Great Britain.—Inquiries to B. SINGER, Steger Building, Chicago, Ill. 7515 H

THE PROPRIETOR of BRITISH PATENT No. 296,229, dated November 15, 1927, relating to "Universal Joint," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 7516 H

THE PROPRIETOR of BRITISH PATENT No. 292,822, for "Improvements in or relating to Valves for Steam and other Engines," is DESIROUS of ENTERING into NEGOTIATIONS with interested parties for the GRANTING of LICENCES thereunder on reasonable terms or for the SALE of the PATENT outright.—Communications please address to Messrs. DICKER, POLLAK and MERCER, Chartered Patent Agents, 20-23, Holborn, London, E.C. 1. 7519 H

THE PROPRIETOR of BRITISH PATENT No. 273,652, for "Improvements in the Husking of Grain," is DESIROUS of ENTERING into NEGOTIATIONS with interested parties for the GRANTING of LICENCES thereunder on reasonable terms or for the SALE of the PATENT outright.—Communications please address to Messrs. DICKER, POLLAK and MERCER, Chartered Patent Agents, 20-23, Holborn, London, E.C. 1. 7520 H

PATENTS TO BE WORKED.

THE PROPRIETORS of the Following BRITISH PATENTS:—

No. 288,947 (G. Regnac-Paille), "Improvements in and relating to Bearings for Rolling Mills;"

No. 293,275 (G. Regnac-Paille), "Improvements in or Connected with Liquid Fuel Burners;"

No. 237,550/268,543-270,768 (Th. Rival), "Improvements in and relating to Automatic Weight Balancing Devices for Beam Balances, Weighing Machines, Weighbridges, and the like;"

No. 273,642 (E. Mertens), "Process for Extracting the Fatty Matter from the Foams Formed by the Beating, Froth Flotation or other Treatment of Wool-washing Waters;"

No. 161,474/175,749-186,763 (H. Kruskopf), "Improved Method of and Means for Extinguishing or Smothering Explosions in Mines;"

No. 289,881/313,843 (R. Merckx), "Improvements in and relating to Lubricating Pads for Axle-boxes of Wheel Axles and the like;"

No. 200,327 (Ch. Torley), "Improved Filtering Material for Water and other Liquids and Process for Preparing said Material;"

No. 246,381 (L. Watteeamps), "Improved White Liquid Paste for Paper and Cardboard and Method of Manufacturing same,"

are DESIROUS of ENTERING into ARRANGEMENTS for the EXPLOITATION of their INVENTIONS in GREAT BRITAIN, under LICENCE or otherwise.

All communications to OFFICE DES INVENTIONS, 63, Boulevard Emile Jacqmain, Brussels, Belgium. 7531 H

THE PROPRIETOR of BRITISH PATENT No. 153,783, dated November 24, 1919, relating to "Improvements in Centrifugal Pumps," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.
All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 7539 H

THE PROPRIETORS of the PATENT No. 224,897, for "Improvements in or relating to Combing Machines," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake and Co., 28, Southampton-buildings, Chancery-lane, London, W.C. 2. 7537 H

For continuation of Small Advertisements see page 4.

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A Seven-Day Journal

The Cheltenham Flyer.

ON Monday last the new Great Western express between Swindon and Paddington came into service. It left Swindon promptly at 3.48—the new schedule time—but instead of arriving at 4.55 in accordance with the time-table, it reached Paddington at 4.47½, having thus covered the 77¼ miles in half a minute under the hour. For nearly 70 miles out of the total distance its speed was generally well over 80 miles per hour, and at mile-post No. 2 from Paddington it was 86·7 m.p.h. The average start-to-stop speed was 77·9 miles per hour. The engine was No. 5000, "Launceston Castle," and the train of six coaches weighed 180 tons. For many years the Swindon–London run has been notable. In 1929 70 minutes were allowed by schedule. That timing has now been reduced by 3 minutes, mainly with the object of recovering a record for British railways. In April last the Canadian Pacific Railway put on a flyer between Montreal and Toronto. It covers the 124 miles in 110 minutes in one direction and 108 in the other, giving start-to-stop speeds of 67·6 and 68·9 miles per hour. The new schedule for the "Cheltenham Flyer" brings the blue riband of the railways back to England with an average speed of 69·3 m.p.h., but for a shorter distance and with a lighter train. If, however, the astonishing timing achieved on Monday and improved on Tuesday can be maintained, a good margin on the British side will be secured.

The Rail-bus.

ON Thursday, September 10th, a demonstration of the capabilities of the rubber-tired railway self-propelling coach, described in our issue of September 4th, was made between Paris and Deauville and back. For this run the ordinary expresses are given 2 h. 47 min., but the rubber-tired coach, or "Micheline"—to adopt the generic name now given to the type in France—covered the distance in 2 h. 3 min., or at an average speed of 66 miles per hour, as compared with the schedule speed of 53 miles per hour. The running was, of course, excellent, and there was naturally far less noise than that produced by a train. If there is nothing remarkable about the speed attained by a single vehicle, the test was of interest as showing that the rail coach may be run satisfactorily over long distances, and that the rubber-flanged tire can negotiate points, crossings, and other features of railway construction. The engine of the coach is an "Hispano," with a French rating of 46 H.P. This is probably the same engine which is rated at 45 H.P. for taxation in this country. If so, the actual horse-power developed on the run may have reached between 100 and 150.

New Chairman for Parsons'.

LAST Wednesday the directors of the Parsons Marine Steam Turbine Company, Ltd., appointed Mr. R. J. Walker, C.B.E., to succeed the late Mr. S. F. Prest as chairman of the company, in addition to his position of managing director. Mr. Walker has been associated with the Parsons Marine Steam Turbine Company, Ltd., for a period of thirty-two years, joining Sir Charles A. Parsons in 1899. For the past twenty-five years he has been joint managing director with the late Sir Charles Parsons and in March this year was appointed vice-chairman and managing director. Mr. Walker was created a Commander of the Order of the British Empire in 1920; he is a Vice-President of the Institution of Naval Architects and a Fellow of the North-East Coast Institution of Engineers and Shipbuilders, besides being a member of several technical societies. He is President for 1931 of the North-East Coast Engineering Employers' Association. He is also chairman of Turbine Steamers, Ltd., of Glasgow.

The Inferiority Complex.

SPEAKING at a luncheon meeting in London on Tuesday last, Mr. G. Hurford, chairman of the British Works Management Association, condemned irresponsible and disparaging comments on Britain's industrial efficiency. He asserted that unless the country generally had a reasoned faith in the future of its industries, and in the capacity of those engaged in managing and directing them, the prospects of an early revival of trade were extremely remote. Most of the criticisms of our industrial ability, he continued, were made by people who did not appreciate the enormous strides which had been made in recent years in raising the standard of productive efficiency. It should be remembered, however, that the British manufacturer was labouring under more handicaps than his foreign competitors in the way of taxes and other non-controllable costs, and it was only those whose lives were spent in the practical side of industry who were aware of the progress that had been made in scientific management and in the use of labour-saving machines in every branch of industry and commerce, all of which were being applied with a greater recognition of essential human values. "One of the most important figures in industry in the future," Mr. Hurford concluded, "will be the works manager. In a sense, he will be primarily responsible for Britain's industrial future. His task, however, is full of difficulties, and the community would be well advised to give him every encouragement and to refrain from making unwarrantable reflections on his ability and vision. Honest criticism is welcome and helpful. The works manager is a leader of labour and one of his many tasks is to secure confidence, and unjustifiable attacks upon his ability make his task doubly difficult."

Asbestos.

THE danger to health arising from exposure to asbestos dust was established by an inquiry conducted last year by the Factory Department of the Home Office. In that report a number of precautionary measures were recommended for the prevention of inhalation of asbestos dust by workmen employed in the industry, the most important of which was the application, both in the textile and non-textile sections, of exhaust ventilation. So far, however, as regarded the textile section, it was evident from the report that further inquiry would be necessary before a decision could be reached as to the best methods to be applied to the various machines in use. A conference was therefore arranged with representatives of the asbestos textile industry, and, as a result, a Committee, consisting of three representatives of the manufacturers and two of H.M. Inspectors of Factories, was set up to consider the best methods which could be adopted generally for the suppression of dust in this section of the industry. This Committee, in April, 1931, made a series of recommendations which were subsequently endorsed by the other representatives of the textile employers. The Secretary of State has decided to give effect to the recommendations contained in these two reports. For that purpose, as required by Section 79 of the Factory and Workshop Act, 1901, he has formally certified as dangerous the manipulation of asbestos and the manufacture or repair of articles composed wholly or partly of asbestos, and processes incidental thereto, and is now issuing, in draft, regulations which follow generally the provisions recommended in the two reports, with certain additions and modifications which have been made after taking into consideration observations submitted by the General Council of the Trades Union Congress.

The Illumination Congress.

ON Monday, September 14th, the delegates of the Illumination Congress assembled at Cambridge, where they were officially welcomed by the Mayor and Corporation at the Guildhall. Subsequently three main subjects were discussed by various committees, namely, street lighting, daylight illumination, and terminology. With regard to street lighting, the classification of thoroughfares with a view to linking it up with lighting, was emphasised and it was pointed out that in Great Britain there was no general scheme to correlate the type of lighting with the traffic characteristics of the streets. It was left to local authorities to select from a series of specified installations a scheme which they regarded as suitable in view of all the circumstances. Most other countries, it was explained, were linking up illumination with a specified type of road; in other words, there was a certain standard of lighting for shopping centres, arterial roads, residential areas, and important thoroughfares.

The Lincolnshire Electricity Scheme.

THE scheme prepared by Mr. R. Borlase Matthews for the electrification of Mid-Lincolnshire and Kesteven has now received the final approval of the authorities, and we understand that the constructional work will shortly be put in hand. The scheme is to be operated by a public company with Mr. Eustace Abel Smith, of Branston, as chairman, and in order to ensure that his proposals are satisfactorily carried out in the interests of Lincolnshire people, Mr. Borlase Matthews will have a seat on the board. For some months past an engineer has been in the area completing the preliminary plans, which are now well in hand. Some slight delay in certain parts of the area is, however, expected, as the company will have to await the completion of some of the Central Board's transmission lines before a supply can be made available. The first town to be electrified will be Skegness, which is expected to have a supply by the spring of next year.

Boiler Explosions.

THE first of the two Boiler Explosions Acts came into force in 1882. The term "boiler" covers any closed vessel in which liquids are heated by any means or into which steam or other hot vapours are admitted. Thus heating apparatus, steam pipes, drying cylinders, rag boilers and all kindred appliances are included within the province of the Act with steam boilers proper. Domestic boilers alone are exempted, but failures of Government "boilers" are outside the usual form of inquiry and boilers of railway locomotives are not dealt with by the Board of Trade, which administers the Acts. Whenever a boiler fails the owner is required to make a report to the Board of Trade, which then sends a surveyor to conduct a preliminary inquiry. If it is then deemed desirable—generally in order to place responsibility—a formal investigation by two Commissioners, one a lawyer and the other an engineer, may be ordered. Since 1882, 3152 explosions have been dealt with. They caused the deaths of 1065 and injuries to 2576 persons. The Report by the Board for the year 1930 has just been published. In that year 55 explosions were the subjects of inquiries, but not a single formal investigation was held. It is satisfactory to note that the number of deaths was the lowest on record, but in recent years fatalities have varied through wide limits. They were as high as 22 in 1924 and as low as 7 in 1925 and 1928. The deaths in 1930 were 5 in number and were caused by four explosions, one at sea and four on land. In only one case was a real boiler concerned; in it the fire-box failed owing to wastage. The other fatal accidents occurred to an old economiser owing to wastage; a steam receiver, over-pressure; a steam chest, water hammer; and at sea, an old copper pipe, vibration.

The Clyde-built Oil Tanker Imperial Transport.

AT the end of last week successful trials were concluded in the Firth of Clyde of the oil tanker "Imperial Transport," which has been built by the Blythswood Shipbuilding Company, Ltd., of Scotstoun, to the order of the Empire Transport Company, Ltd., which is managed by Houlder Brothers and Co., Ltd., London. The tanker has a length of 460ft., with a beam of 60ft., and a depth of 34ft. 6in., her measurement being about 8000 gross tons, with a 11,500 tons deadweight carrying capacity. She is constructed on the longitudinal system, and is classed with Lloyd's for the carriage of petroleum in bulk. There are eighteen main oil tanks, with a deep tank forward and a dry cargo hold, oil-tight cofferdams being fitted at the ends of the oil cargo holds. The bunkers and cargo tanks are provided with heating coils, and there is a single pump-room with two steam-driven cargo pumps, each of which has a designed duty of 300 tons per hour. Accommodation for the engineers is provided in deck houses on the poop, while the captain and deck officers are housed amidships. The propelling machinery consists of a single North-Eastern four-stroke single-acting oil engine with eight cylinders. The heating steam is furnished by two oil-fired cylindrical type donkey boilers. The trials were carried out in the deep loaded condition, and were, we understand, highly satisfactory, a speed of over 12 knots being obtained.

Swedish Oil Engines to be Built in Glasgow.

THE announcement is made that the Aktiebolaget Atlas Diesel Works, of Stockholm, has made arrangements with British Auxiliaries, Ltd., of Helen-street, Govan, Glasgow, to construct two-stroke cycle airless-injection oil engines of the "Polar" design. The parts of British Polar engines are to be interchangeable with the Swedish engines, and the engines will be marketed by the Atlas Diesel Company, Ltd., of London. The Glasgow company was, it will be recalled, formerly known as Fiat British Auxiliaries, Ltd., but it has been recently reconstructed, and on its board of directors there are represented several of the most important shipping interests in this country. The chairman of the company is Sir Frederick Lewis, Bart., while other directors are Mr. J. C. Cowan, Viscount Glenapp, Mr. E. W. Harvey, Mr. I. P. R. Napier, and Mr. John H. Silley. The range of engines which are to be manufactured at the Govan works will include, we learn, airless injection units for propulsion and marine auxiliary services, and engines for power stations and other industrial purposes.

The Opening of the Olympia Exhibition.

LAST Thursday, September 10th, the Shipping, Engineering and Machinery Exhibition at Olympia was opened by Sir Austen Chamberlain, First Lord of the Admiralty. Admiral of the Fleet Lord Wester Wemyss, President of the Exhibition, was in the chair. Opening the Exhibition, Sir Austen referred to the difficult times through which industry was passing. He was there in his capacity as First Lord to express the interest and sympathy of the Government in the Exhibition. The vital strength of the trades represented was exemplified by the fact that they could provide so magnificent an Exhibition. At the luncheon which followed upon the opening ceremony, considerable interest was aroused by the arrangements which had been made for communicating by wireless telephony with ships at sea. Conversations were carried on by the chairman with the captains of the "Empress of Britain," lying at the time about 700 miles west of the Scilly Isles, and of the "Homeric," about 150 miles west of Cherbourg. By means of loud speakers erected in the room the guests at the luncheon were able clearly to hear both sides of the conversations. Sir Alan G. Anderson proposed the toast of "Sir Austen Chamberlain," who, replying, expressed his faith in British industry and said that he believed it could hold its own, the more successfully, he added, when, as he believed would shortly happen, it got fair terms for competing with those with whom it was in contact. The remark was greeted with acclamation.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. II.*

LAURENCE SCOTT AND ELECTROMOTORS, LTD.

SEVERAL types of electric winches and electric motors are exhibited by Laurence Scott and Electromotors, Ltd., of Norwich. Besides the totally enclosed Emcol D.C. motor for use in places where acid fumes are present and where other adverse conditions are met with, the firm is exhibiting a mill motor built on very robust lines. In the manufacture of these machines the built-up or fabricated principle is adopted, and, as will be seen from the illustrations Figs. 22 and 23, the armature shaft extends from both ends of the machine, so that either end may be used for driving. The end plates are welded to the wrought steel frame and the cast steel bearing

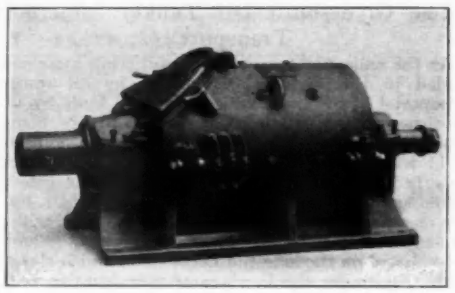


FIG. 22—MILL MOTOR—LAURENCE SCOTT

housings are welded to the end plates. As the illustrations show, the frame feet extend along the full length of the machine. It will also be perceived that the frame is in two parts, and the top part can be opened on either side of the machine, according to which side is most convenient. Access to the commutator may be obtained by lifting the hinged cover to be seen on the left of Fig. 22. Four large bolts and two taper dowels serve for holding the two parts of the casing together, whilst eye bolts are provided for lifting either the upper half of the motor or the complete machine. The four main poles are composed of laminated steel, whilst the interpoles are composed of solid steel.

The asbestos-covered field windings are insulated from the frame by micanite, the conductors consisting of copper strip wound on edge. Each bearing is provided with a steel sling, which is always in position and is ready for lifting the armature shaft and bearings clear of the carcase. All the machining on the carcase is done after welding. When the overall length of the

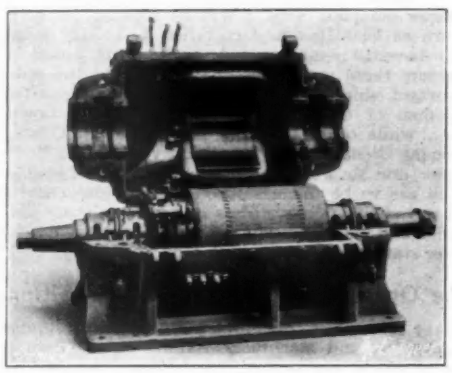


FIG. 23—MILL MOTOR, CASING OPENED

motor is a consideration, as, for example, in the case of motors on cranes, &c., the motors can be provided with heavy type roller journals with ball location. Two split oil rings serve for lubricating each journal, and the bushes are designed so that the rings cannot jump clear of their grooves, whilst leakage of oil from the bearings is prevented by oil-throwers at each end. The armature shaft is forged from high-grade steel and is tested to comply with a rigid specification. The extensions at the end of the shaft can be tapered or be made parallel, and when tapered two lock nuts and washers are provided. The shaft extension that is not used for driving purposes is protected by a fabricated steel cap. The shaft may easily be removed from the armature.

The armature core is built up under hydraulic pressure and is bored and shrunk on to the spider, the only form of construction, the makers claim, that can be relied upon to maintain a tight armature under jarring loads. The fabricated winding supporting drums are welded to the spider. According to the amount of current with which they have to deal, the armature windings are composed of copper wire or strip and are former wound. Individual bars are served with micanite tape, and the requisite number of bars required for a slot are again treated with another serving of micanite and then laid in a micanite trough in the armature slot, the conductors being held in place in the slot by bakelite wedges. The end windings are secured by steel wire binders. The commutator, which constitutes a separate unit, is forced and keyed on to the armature spider. On all these motors four brush arms are provided, and the holders, which are built up on a steel shank with moulded mica insulation, are radially clamped to the rocker. The brush rocker is in two parts, and it is possible to separate the upper part of the rocker and to remove the armature without

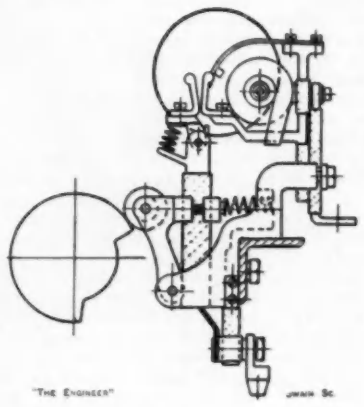


FIG. 24—CONTACTS OF CAM-OPERATED STARTER

dismantling the brush gear. The field and armature connections are brought outside the machine through tight fitting insulated bushes, and each end is provided with a double connector. In the design of these machines an endeavour has been made to facilitate the work of dismantling the parts for overhaul, which simply involves swinging back the top half of the carcase and raising the armature by means of the special bearing slings provided. The machines are dustproof and practically water-tight, and are capable of withstanding the most arduous working conditions.

Drum and cam-operated contactor type marine starters constitute other Laurence Scott exhibits. By simply opening the door of these starters, which are built on the firm's well-known metal and mica

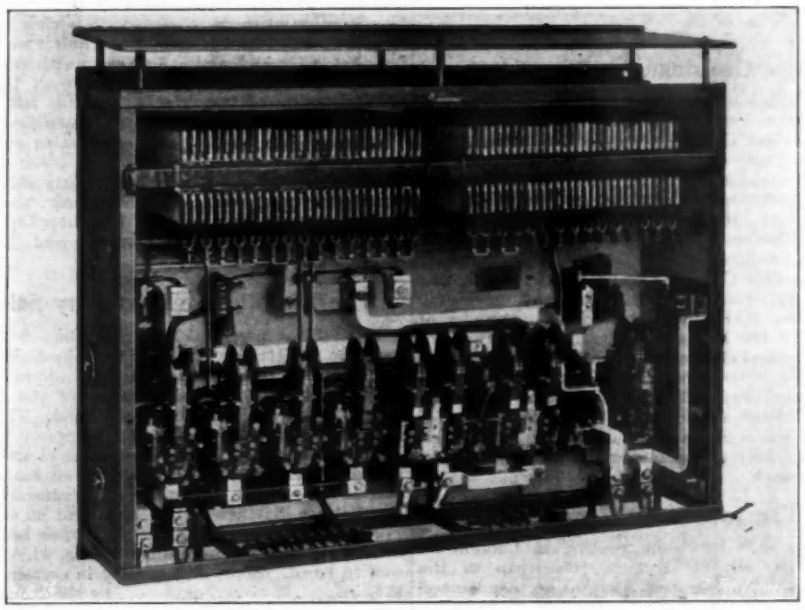


FIG. 25—REVERSING CONTACTOR CONTROLLER FOR WINDLASSES—LAURENCE SCOTT

principle, all the parts become visible and accessible. All these starters, with the exception of the smallest, have a double-pole contactor circuit breaker, with a powerful magnetic blow-out for each pole, and the armature circuit is always made and broken by the circuit breaker. If the slow-motion starting handle, which is pressed in against a light spring, should be released or turned back during the starting period, the circuit breaker opens and it is necessary for the operator to start again from the first step. Inching mechanism is combined with the starting handle.

The resistances are in the form of metal tubular units, which are cooled on both sides, and insulated with micanite, which is protected in turn with asbestos millboard, on which the heavy gauge rustless resistance wire is wound. They are rated to comply with the B.E.S.A. specification, and one-minute heavy-duty starting is provided for. The two overload releases which operate the circuit breaker have finely adjustable time lags, no fuses being required. The main connections are composed of stiff copper rod insulated with hot moulded micanite where necessary. Shunt and relay circuits are composed of fire-resisting 2500 meg cable, grouped in micanite wrapping where cleated to the case. All ferrous parts are protected against corrosion by cadmium plating. The cases are composed of ¼in. sheet steel, electrically welded at the corners. Moving iron or moving coil ammeters and shunt regulators are fitted as required.

The drum and barrel type of starter for medium

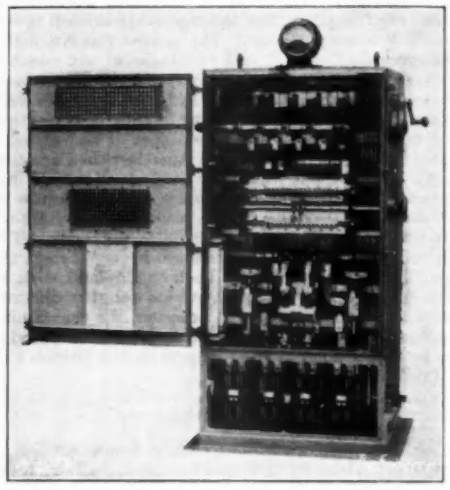


FIG. 26—CAM-OPERATED STARTER—LAURENCE SCOTT

powers has proved itself very reliable under marine conditions, and has been found to require the minimum amount of maintenance.

The design of the barrel regulator ensures that the motor always starts with full field without the operator having to return the regulator to the slow-speed position. A few extra steps on the barrel come into operation between the last starting step and the "on" position, and by a special arrangement of resistances smoothly accelerate the motor up to the speed set by the regulator. The same arrangement can be adopted to give up to 50 per cent. shunt regulation, with five to eight steps, without a separate regulator, an arrangement which is very suitable for small pumps, fans, &c., which do not require fine regulation.

The cam-operated starters are designed for greater outputs and for more onerous duties than the drum starter. The heavy contacts—see Fig. 24—of the cam-operated contactor unit occupy less space than the equivalent barrel contacts and fingers, and the contact pressure is greater, though the starting handle is easily turned. The last contactor has a heavy laminated brush. Shunt interlocking contacts for more than 50 per cent. regulation are carried on a section of barrel mounted on an extension of the cam shaft. A 250 H.P. cam-operated starter is shown in Fig. 26, whilst Fig. 25 shows a reversing contactor controller for windlasses. Other exhibits on the stand consist of hand-assisted steering gear, a trawler

* No. I. appeared September 11th.

capstan and examples of the Burke-Scott electric welders, as described in our issue of July 10th of this year.

BATTERIES, LTD.

Batteries, Ltd., of Redditch, are exhibiting a wide range of nickel cadmium accumulators, with a steel case and alkaline electrolyte. As the batteries are not subject to sulphation, they can stand for long periods without self-discharge or deterioration, and they are claimed to be particularly suitable for yacht lighting. They are also claimed to offer marked advantages for emergency lighting, and the internal resistance of the latest batteries of this type is said to be lower than that of any other type of battery. Cells are shown for emergency lighting and steering, yacht lighting, and Diesel engine starting, and demonstrations of the uses of the cells are being made. A wide range of hand-lamps, flood-light sets and portable searchlights which embody "Knife" cells is also shown.

THERMOTANK LTD.

Types of ventilating fittings are exhibited by Thermotank Ltd., of Govan, Glasgow. A number of fittings of the punkah louvre type are shown in action under normal working conditions to demonstrate how they can be adapted for use for various purposes. A sectional drawing of one type of punkah louvre is given in Fig. 27, from which

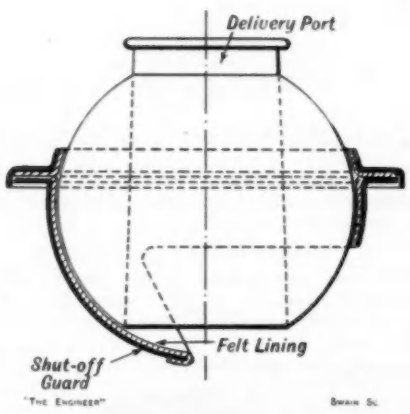


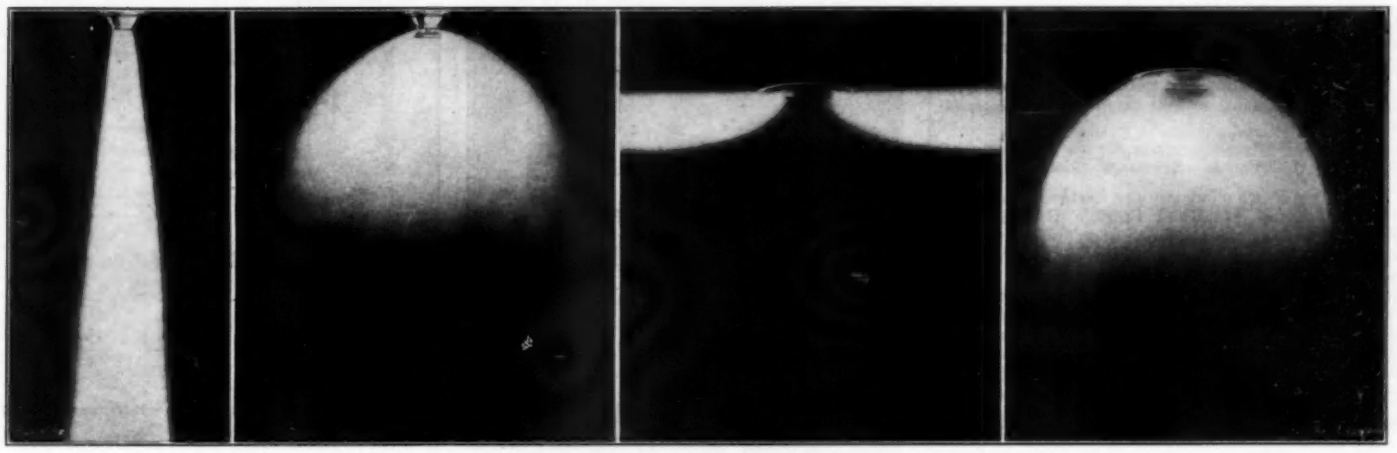
FIG. 27—PUNKAH LOUVRE—THERMOTANK

it will be seen that a hollow sphere, having a cylindrical outlet at one side and a circular opening at the other, fits into a collar-like support. Air is delivered by a fan to this device, and by rotating the sphere the stream issuing from the cylindrical outlet may be delivered in any desired direction. The makers claim that ventilation by means of this device is an improvement upon that in which the air is delivered at low velocity through gratings. The velocity of air delivered through the punkah louvre is from 30ft. to 50ft. per second, and, owing to the directional properties of the louvre, no discomfort need be caused by this speed of delivery. The air is delivered almost noiselessly. It is claimed that the turbulent condition caused by the high air velocity prevents any possibility of temperature stratification, while, when it is required, a breezy atmosphere similar to that produced by a fan can be obtained by directing the air stream in the desired direction.

Since it was first brought out various developments have been made in the punkah louvre ventilating system. On the makers' stand louvres which revolve automatically while delivering the air and diffusing louvres which give a diffused stream of air are shown. For use in cabins on board ship and similar places where it is desirable that individuals should be able to control the supply of air, Thermo-Reg louvres, which deliver warm, cold or mixed air, according to the position of the sphere relative to the collar, are shown. The series of photographs reproduced in Figs. 28 to 31, shows the various ways in which the air delivecy may be diffused when a diffusing louvre is used. In Fig. 28 the delivery from the ordinary louvre can be seen, while Fig. 29 shows the effect of fitting a diffuser. The distribution of air along the ceiling or downwards when a distributor is used can be seen in Figs. 30 and 31, the type of discharge being altered by a slight adjustment of a deflector plate.

Besides the punkah louvres, a number of thermostatic controls are exhibited on the stand. An electrically operated valve is fitted to a Thermotank heating unit to control the supply of steam to air heaters and humidifying pipes. The valve is operated by a solenoid, which is energised through a relay under the control of a thermostat in the region being heated. The steam is automatically shut off when the fan motor is shut down owing to the fact that the solenoid is energised from the motor terminals.

The photograph reproduced in Fig. 32 illustrates a remotely operated thermostat. The panel shown is arranged for the control of forty individual thermostats. In its centre there is a selector switch, which



FIGS. 28 TO 31—AIR DELIVERY WITH DIFFUSERS AND DISTRIBUTORS—THERMOTANK

FIG. 32—THERMOSTAT CONTROL PANEL—THERMOTANK

permits connection to be made with each individual thermostat. The push-buttons at the bottom, marked C and D, raise or lower the setting when pressed, and B causes the setting to be indicated on the scale near the top of the board.

FRY'S METAL FOUNDRIES, LTD.

Fry's Metal Foundries, Ltd., of 25, Holland-street, Blackfriars, London, S.E. 1, are showing a complete series of anti-friction alloys, from the highest grade metals specially designed for aero and C.I. engines, to the general purpose metals of the Magnolia character, the object being to demonstrate the fact that varying grades are necessary for the many services of the engineer, and that whether the alloy be a rich tin grade, free from lead, for an internal combustion engine of the highest class, or a lead base metal for a simple truck, no variation in quality is admissible. The particular grade is designed for its special purpose. Composition and, therefore, price are in relation to the service. Phosphor bronze for bearing bushes in several grades is also a feature, while there are examples of general foundry castings in non-ferrous alloys. Brasses, bronzes, aluminium alloys and high nickel alloys of the non-corrosive varieties are all represented.

A comparatively new departure for this firm is the production of cast iron of easy machining grades, and also heat-resisting irons, but probably the most attractive exhibit is the collection of die castings of every known type. These include gravity work in lead base, aluminium base and aluminium bronzes; pressure castings showing the products of each class of machine in various alloys, from zinc base or white brass work, of high tenacity and toughness, to aluminium alloy castings produced under air pressure. The delicacy and refinement of work that is possible is shown. Finally, yellow metal and other castings produced by the Polak process, which is Messrs. Fry's exclusive property in the British Empire, are exhibited.

SIEMENS BROS. AND CO., LTD.

Many of the exhibits on the stand of Siemens Bros. and Co., Ltd., of Woolwich, have been shown at previous exhibitions. Among other things there are ships' telegraphs, a revolution indicator, a helm indicator, a navigation light indicator, ships' wireless

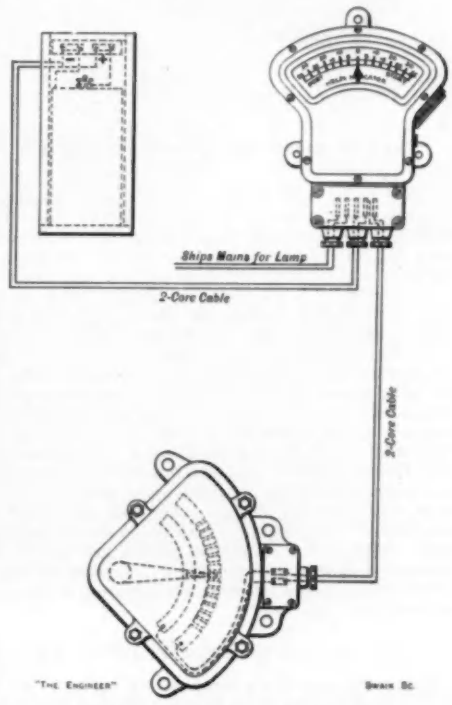


FIG. 33—HELM INDICATOR—SIEMENS

equipments, and automatic telephones. The helm indicator, which is, perhaps, one of the most interesting marine exhibits, indicates the angle of a ship's rudder or helm in a positive and reliable manner on the bridge, or in any other desired position, and is operated by a single dry cell. The amount of current consumed by the instrument is said to be so small that the battery need not be renewed more frequently than once a year. The angle of the rudder or helm

is indicated in 2½ deg. steps up to 20 deg. port and starboard, and in 5 deg. steps for the remainder of the scale without backlash. A switch, an indicator and the battery constitute the complete equipment, as shown in Fig. 33. The switch, which is enclosed in a watertight case, may be placed either in the steering gear house or between decks near the rudder post, and the angular movements of the rudder are transmitted to the switch by means of levers and links, which are connected to the rudder post and to the spindle projecting from the switch case. Usually, the indicator, which is mounted in a watertight gun-metal case, is placed in the wheel house, or on the navigating bridge. For illuminating the dial at night the indicator is provided with an electric lamp, which is supplied from the ship's mains. The electrical connections between the transmitter switch and indicator and between the latter and the battery are made by means of a two-core cable. In the event of the cable being broken, or the supply of current to the indicator failing the pointer of the indicator disappears from sight, so that an incorrect indication cannot be given.

CHLORIDE ELECTRICAL STORAGE COMPANY, LTD.

Marine Exide ironclad storage batteries exhibited by the Chloride Electrical Storage Company, of Clifton Junction, near Manchester, represent the various types of batteries installed on many of the most notable ships recently completed. Exide batteries are used on all types of craft, ranging from dredgers to electrically propelled passenger liners and luxury yachts. A battery for yacht and for general marine work is shown with the case and interior cut away in order that visitors may study the internal construction. Another exhibit is an

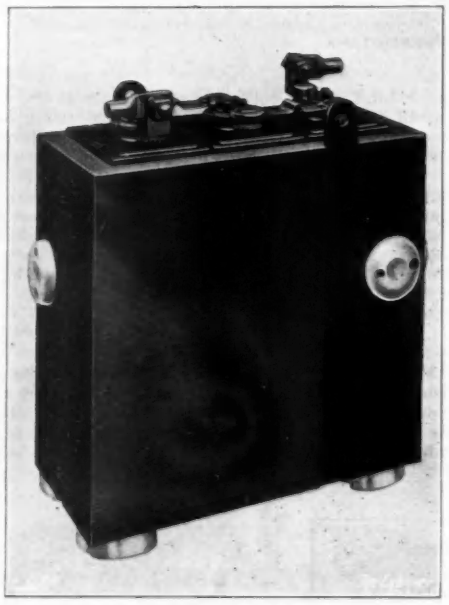


FIG. 34—EXIDE CELL GROUP—CHLORIDE

Exide-ironclad cell of the largest size, as used for the propulsion of submarines. Exide Ironclad batteries are designed to meet special conditions, such as heavy discharges, continuous mechanical vibration and swirling of the electrolyte. The positive active material is enclosed in ebonite tubes, with slits, and is securely held in contact with the grid, which conducts the current to the terminals. The standard method of installing Exide Ironclad batteries for marine duty is shown by a specimen group of six cells, assembled in an insulated teak crate with lifting handles. A group of three cells for marine service and assembled in a teak crate is shown in Fig. 34. For wireless and other comparatively light duties, batteries in glass and ebonite containers are displayed, and among these batteries are "mass" type cells specially designed for long and slow or intermittent discharges. These batteries are particularly suitable for operating electric clocks, bells, telephones, alarms and signalling apparatus on ships, and for other classes of service necessitating recharging at infrequent intervals.

WILD-BARFIELD ELECTRIC FURNACES, LTD.

Automatic hardening furnaces are being shown in actual operation by Wild-Barfield Electric Furnaces, Ltd., of Elecfurn Works, North-road, Holloway, N. 7. By detecting the moment when the last trace of magnetism leaves the steel, the exact quenching instant for steel parts is indicated, for when quenched at this point steel has the finest possible grain structure, and the greatest resistance to wear. An improved Wild-Barfield carburising and general heat treatment furnace is fitted with the standard automatic temperature control device, which has been designed to minimise the work involved in setting up the equipment when the furnace has been installed. Two examples of high-speed steel-hardening equipments of different size are on view, the largest being fitted with the maker's patented automatic input control, which is said greatly to lengthen the life of the elements. As in the case of the other types of furnaces, every endeavour has been made to reduce running costs and to avoid trouble.

Another exhibit is a pusher type furnace, which is claimed to be an ideal furnace for dealing with quantities of production parts, such as gudgeon pins and similar articles, as no energy is wasted in heating conveyors or similar arrangements. The work is pushed through the furnace by reciprocating arms, driven through reduction gear by a motor mounted on the main framework, the apparatus thus being

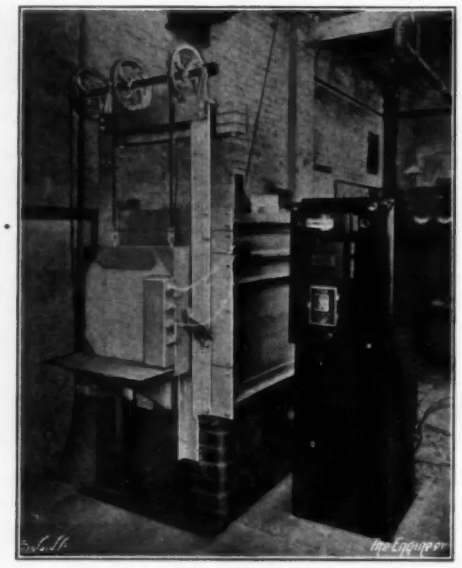


FIG. 35—CARBURISING AND HEAT TREATMENT FURNACE—WILD-BARFIELD

compact and occupying a small amount of floor space. The Vickers Diamond hardness testing machine, and the Vickers projection microscope are also on view.

The improved carburising and general heat treatment furnace and its automatic temperature control gear are shown in Fig. 35, whilst Fig. 36 shows the heating elements and the method of supporting them, the guards being removed. These new elements consist of heavy nickel-chrome hairpin rods, which extend along the complete length of the furnace, on the roof, walls, and floor, and, if necessary, on the door and back for furnaces up to 8ft. or 10ft. long. These elements are claimed to offer many advantages. Even when the furnace is at its working temperature, an old element can be withdrawn by unscrewing two

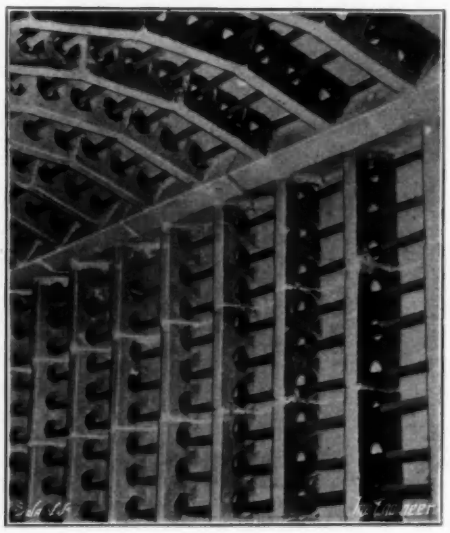


FIG. 36—HEATING ELEMENTS—WILD-BARFIELD

nuts at the back, when the hairpin element can be pulled out of the chamber with a pair of tongs. A new element can then be inserted into the furnace with equal ease, and the ends can be bolted to the bus-bars at the back. In common with the firm's other types of elements, the new type has a long life, and when the time comes for renewal the necessary work involved can be carried out by the user. For furnaces over 8ft. or 9ft. long, use is made of heavy-duty drawn rod elements of sinuous form.

The pit type forced draught oven shown in Fig. 37 represents the firm's latest equipment for tempering and for certain other forms of low-temperature heat treatment. The natural convection is augmented by a patented paddle fan placed under the oven chamber. Owing to the provision of this special fan, the rate of heating and the resulting output of heat-treated work are greater for a given size of oven or furnace than they would be in the absence of the fan. The curve, Fig. 38, shows the relation between the rate of heating with and without the fan. The arrows in the drawing, Fig. 37, show the direction

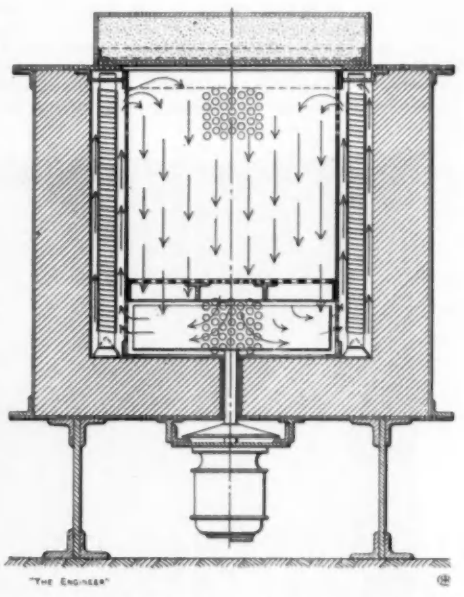


FIG. 37—FORCED DRAUGHT OVEN—WILD-BARFIELD

of the air stream, which passes over the heating elements and round and through the charge. The rate of heating of the charge and the moment when it reaches the required temperature are recorded by an arrangement of thermo-couples, thus relieving the operator of the responsibility of determining when the charge is ready for withdrawal. By suitable modification this type of furnace can be used for other kinds

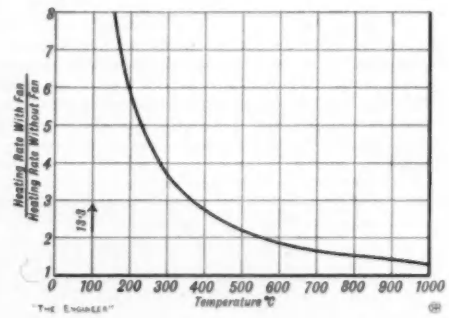


FIG. 38—HEATING RATE OF FORCED DRAUGHT OVEN

of heat treatment, such, for example, as the heat treatment of non-ferrous metals, both in sheet and in the finished form.

BRITISH QUADRUPLEX, LTD.

The type of rotary pump made by British Quadruplex, Ltd., of 27, Walnut Tree-walk, Kennington, is illustrated in Fig. 39, and the diagram Fig. 40

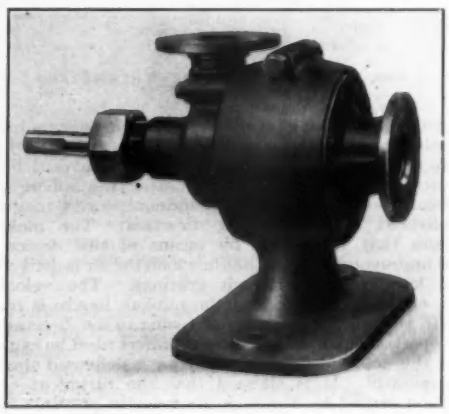


FIG. 39—ROTARY PUMP—QUADRUPLEX

shows the method of operation. The fluid being pumped passes along the bore in the shaft, as shown in the lower diagram. This bore is divided into two parts by a sloping wall of metal, so that the fluid must pass out of the bore by the port S and into it again by the port D. Turning to the other diagrams in the same figure, it will be seen that the shaft has an excentric mounted upon it and rotates within

an inner member of square section that can reciprocate in an outer member, of rectangular section, and also capable of reciprocation in the main casing of the pump. Looking at I, it will be seen that the space to the right of the outer member and that below the inner member are both increasing. Liquid is, therefore, drawn in by the suction part S of the shaft into these spaces. At the same time, by a similar action, liquid is delivered from the left side of the outer member and the top of the inner member through the delivery port D. It will be noticed that the reciprocations of the inner and outer members are, so to speak, 90 deg. out of phase the one with the other, so that sensibly constant delivery is attained. It

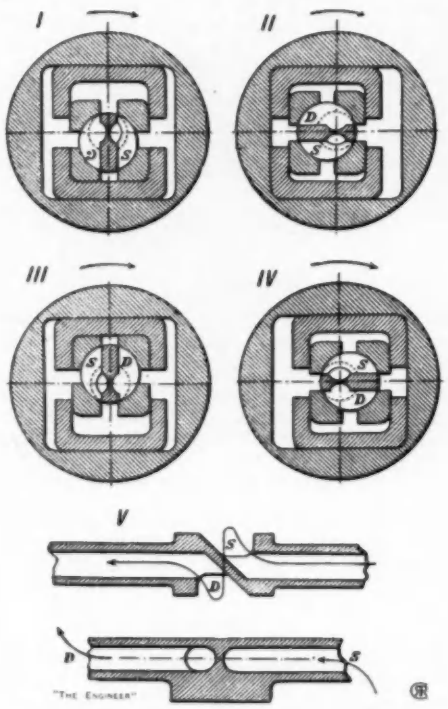


FIG. 40—ACTION OF QUADRUPLEX PUMP

will also be seen that the pump has only three working parts.

On the makers' stand a variety of these pumps is shown. In particular, one designed for pumping milk attracted our attention. Since, for hygienic reasons, the pump must be regularly cleaned, it is arranged for rapid dismantling. The end cover is removed by unscrewing it from the casing, and each separate part can then be easily removed. All the parts are so accurately made that they can be replaced in any position. For instance, the inner member can be inserted in the outer with any of its four sides uppermost.

All pumps are directly reversible. In order to change the direction of flow of the liquid, it is only necessary to reverse the rotation. There being no distinction between the delivery and suction sides of the pump, it works equally well with either direction of rotation. It has, of course, a positive action, and at constant speed delivers sensibly the same quantity against any head.

Pumps are also to be seen on the stand arranged as air compressors, while special designs for use with petrol and other liquids are exhibited. They can be arranged for direct motor drive, for drive through worm and wheel, or for hand operation.

BRITISH OXYGEN COMPANY, LTD.

Many parts previously made by casting or forging can now be made by oxygen-cutting machines, with a finish as good as and frequently better than that given by the older methods. In other cases these cutters enable parts to be formed from the solid in a time much smaller than that which would be required if sawing and filing were resorted to. The British Oxygen Company, Ltd., of Angel-road, Upper Edmonton, is showing a number of oxygen cutting machines and a variety of parts that can easily be cut by their use. The machine illustrated in Fig. 42, which has been produced by the firm for a number of years, has recently been improved. The main features of the design can easily be followed by reference to the engraving. The cutter is carried upon a robust elbow arm. Upon an arm above it there is fixed a plate beneath which the template which is to guide the cutter can be clamped. A serrated wheel above the cutter makes contact with the template and being magnetised retains contact with it. The wheel is driven through shafts from a motor mounted upon the column which also carries a multi-speed gear-box of the disc and wheel friction type. A large indicator reading the cutting speed directly, in feet per minute, is fitted. The gearing is enclosed and all shafts run in ball bearings. The height of the cutter above the job is adjustable while the machine is in motion to allow for the requirements of jobs having differing metal thicknesses in various parts, while the heating and cutting oxygen are controlled by a single hand wheel once a setting has been obtained. The work-table can accommodate jobs up to 20in. in depth. The machine has a wide range of utility.

A device for cutting joists and similar pieces is illustrated in Fig. 41. This is a simple affair for which the engraving is almost self-explanatory. It is fitted with longitudinal and cross slides operated by hand wheels. The height of the cutter above the job can be adjusted by means of a conveniently placed

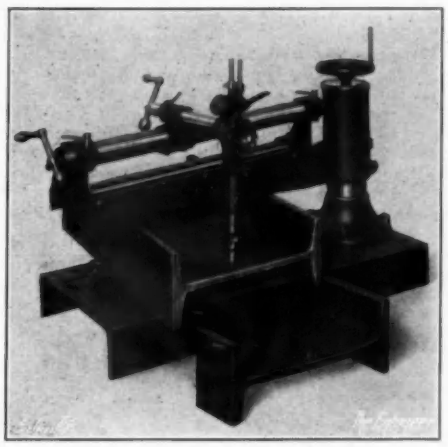


FIG. 41—JOIST CUTTING MACHINE—BRITISH OXYGEN

hand wheel. In operation the flange is first cut and the web about two-thirds severed. A cut is then started upon the other flange and the cutter traversed across until the two cuts meet.

A new production of the British Oxygen Company, Ltd., which is exhibited on its stand is a profiling machine for cutting parts directly from the blue print or drawing, and is particularly useful for producing small parts, of which only one or two are required to each pattern. The cost of making a forging or a casting, it is claimed, is unjustified if

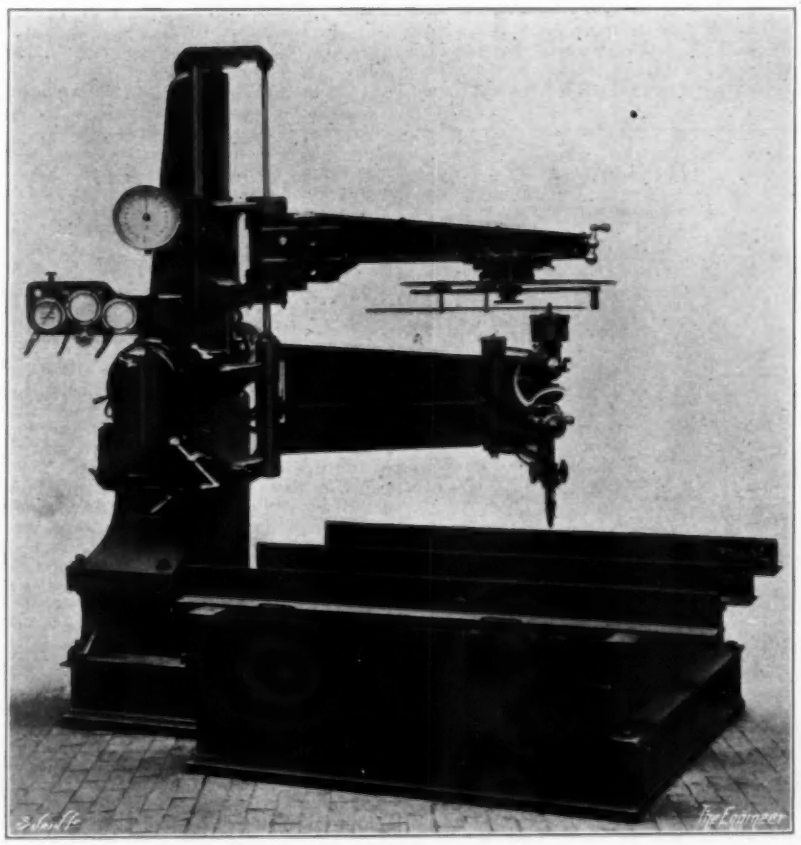


FIG. 42—UNIVERSAL CUTTING MACHINE—BRITISH OXYGEN

use can be made of one of these machines. In essentials it consists of a trolley carrying the motor, with the cutting pipe mounted upon another trolley in such a way that a considerable area can be covered. The cutting table is placed below and to one side of the board upon which the drawing or blue print is placed. The motor drives through small gears a wheel with a serrated edge, which can be guided along the lines of the drawing by means of a handle above. The machine exhibited has the quite small capacity of 1ft. 6in. by 3ft., and cuts steel up to 5in. in thickness, but sizes up to 10ft. by 3ft. are made by the firm. Oxygen cutting equipment of all kinds is shown upon the stand.

THE BRITISH THOMSON-HOUSTON COMPANY.

One of the exhibits of the British Thomson-Houston Company, of Rugby, is a main propulsion contactor, as used in connection with the control equipment for turbo-electric ships. In the company's alternating-current electric propulsion equipments, it is necessary for starting or stopping the ship to use some form of circuit opening and closing device in the main power circuit to the propeller motors, together with a means of reversing the flow of current in the motor stator coils. The operations to be performed are those of opening or closing the main circuit for "ahead," and opening or closing the circuit with the phases reversed for "astern" rotation of the propeller motors. As in the case of emergency, any delay in any of these operations may mean damage to the ship or even complete loss, reliability is of great importance. It must also be remembered that these switches may be operated much more frequently than those of similar capacity for land installations, and that on land nothing that is electrically operated has the tremendous inertia of a large moving ship. The conditions to be met are therefore exceptional.

After long and careful study of the conditions at sea the British Thomson-Houston Company decided that the best solution of the problem was to be found in the use of air break contactors, and they were consequently employed in the control equipment of the s.s. "San Benito," 3000 S.H.P., which was built in 1920. Since that time this type of control switch has been used in connection with every B.T.H. turbo-electric propulsion equipment, and the contactor with its operating lever shown on the stand—see Fig. 43—represents the latest type of main propulsion contactor, as employed on the new P. and O. liners "Strathnaver" and "Strathaird" for the control of the two 14,000 H.P., 3000-volt, three-phase motors installed on each ship. As will be gathered from the illustration, only one lever is used for normal electric and mechanical and mechanical emergency operation.

In view of the number of operations which may be necessary when docking a vessel, it is desirable that the effort required for closing and opening a contactor should be reduced to a minimum, and a solenoid, energised by the movement of the operating lever, is therefore used for closing and opening the contacts under normal conditions. Rapid closing or release of the contact tips is thereby secured, with consequent long life and freedom from the necessity of frequent adjustment. After the electrical release of the contact tips, springs and the weight of the moving parts are utilised to effect the opening of the switch. In the event of a solenoid circuit failing when it is required to close a contactor, the mechanical gearing, consisting of cams and push-rods, is brought into play, and the increased effort on the part of the operator of the control lever immediately indicates

what has happened. The equipment can still be operated mechanically until such time as it is convenient to attend to the electrical gear. If the contact tips of the contactors should weld or stick together, owing to excessively heavy currents, the "knock-out" mechanically opens the contactor.

Another interesting exhibit is a 12 H.P. vertical spindle, variable speed, D.C. motor, driving a Drysdale pump, as shown in Fig. 44. The motor is of deluge-proof construction, and has separately housed ball bearings and a duplex thrust bearing of substantial design. Large lifting bails enable the whole pump unit to be lifted, and the design of the end shields and bearings

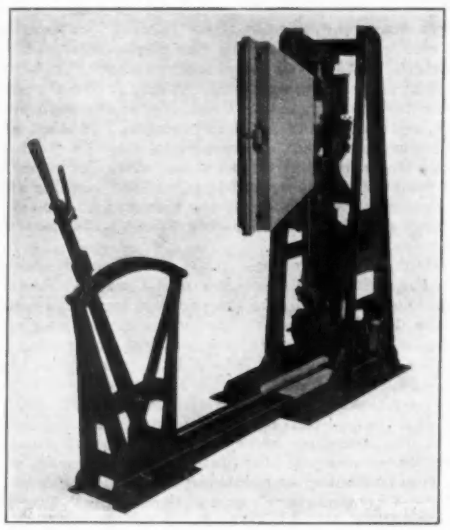


FIG. 43—MARINE PROPULSION CONTACTOR—B.T.H.

enables the armature to be removed without dismantling the motor. A 6 H.P. silent, horizontal-spindle D.C. motor—see Fig. 45—designed to meet the specifications of the larger shipping companies for conditions where special refinements in addition to general reliability and robustness are required, embodies separate bearing housings, which can be supplied with either sleeve or ball and roller bearings, while on the larger sizes the frame and end shields are split for ease of dismantling. A 15 H.P., horizontal-spindle, D.C. motor is also shown. This machine has been designed for general marine service where refinements such as those called for by the larger

FIG. 44—VERTICAL MOTOR AND PUMP—B.T.H.

shipping companies are not required, special features of the machine being a rolled steel frame, and the heavy cast louvered covers. Although the motor shown is for service below deck, it can also be supplied suitable for the exposed deck. The brush holders fitted to these machines are of a new and patented design. As the brush box is separate and detachable from the shank carrying the tension springs, any brush-box can be removed without in any way interfering with others on the same spindle. Another point which makes these motors eminently suitable for marine service is the insulation—double cotton-covering is used for the armature and field conductors, whilst the armature slots have a lining of mica, and the field coils a wrapping of mica, all specially treated to meet the most severe conditions of service. In addition to the three medium size D.C. auxiliary motors, a silent-running squirrel-cage machine is shown.

The control gear for use with the D.C. motors has also been specially designed for marine service. Both drum and face plate type starters are shown in operation, and, whilst they are primarily arranged for bulkhead mounting, stools are provided for deck mounting. They are of drip and splash-proof construction, and are suitable for service below deck. With the exception of the smallest size, the drum type starters are operated by a ratchet lever, giving definite "step-by-step" control. An electro-magnetic circuit breaker is provided in each line, and is interlocked with the starter, so that it must be returned to the "off" position before the circuit breakers will close. In the event of the attendant leaving the starter in any but the "full running" position, the circuit breakers automatically open, thus preventing risk of damage to the starting resistances. A shunt field rheostat for speed control is electrically interlocked with the starter, so that the motor cannot be started on a weak field. An ammeter, illumi-

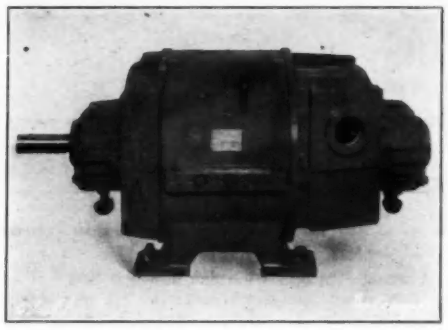


FIG. 45—6 H.P. SILENT MOTOR—B.T.H.

nated by a pilot lamp, is also provided. The whole panel is enclosed in a robust pressed steel case, with a hinged cover and detachable cable-box, which is arranged to take either cable glands or conduit. The firm's face-plate type starter has renewable contacts, a line switch, main fuses, under-voltage and overload protection, all mounted on a Sindanyo base. A cast iron case encloses the starter, and is fitted with a hinged and glazed cover, which can only be opened when the line switch is in the "off" position. This starter also has a detachable cable-box to take either conduit or cable glands. For variable-speed motors the enclosing case is of sheet steel.

Another exhibit of interest is an electric tachometer consisting of a small generator driven through gearing by a variable-speed B.T.H. fractional H.P. motor and a speed indicator and revolution counter. The company's ship's sound-amplifying equipment, for amplifying gramophone records, &c., is also on view, whilst other exhibits consist of Mazda lamps, modern Ediswan electric light fittings for marine use, fractional horse-power motors, Fabroil silent pinions, and magnetos.

BLACK AND DECKER, LTD.

The chief item of interest on the stand of Black and Decker, Ltd., of Slough, Buckinghamshire, is a selective speed independent spindle buffer, which is a new design. The photograph we reproduce in Fig. 46 is a view looking down into the interior of the machine showing the drive. The important point is that the two spindles are independently driven by separate belts. The driving motor, which is constructed for extra heavy duty, has sufficient capacity for the heaviest work. It is mounted upon a plate hinged at the top, and by the use of a hand wheel projecting through the bottom of the casing of the machine, this plate may be swung inwards or outwards by means of a screw mechanism, thus providing a means of adjusting the tension of the belts. The drive to the spindles of the machine is through belts of the interrupted "V" type, there being two belts to each spindle. Each spindle can be independently stopped or started by means of a multiple disc dry clutch. When the clutch is disengaged, a brake is automatically applied to the spindle concerned. In order that the life of the machine may be long, the spindles and all rotating shafts are mounted on ball bearings protected from dust by all-metal frictionless labyrinth seals. The machine is controlled by push buttons, which are mounted at the front and top of the base in a position convenient to the hands of the operator. It will be seen that the base is heavy enough to absorb the vibrations likely to occur owing to the use of out-of-balance wheels, while it is constructed to have a three-point contact with the floor to ensure proper support. Grinding machines of various types, all electrically driven, are to be seen on the stand. The wheels of these machines are entirely enclosed, except, of course, at the grinding face, by guards, the outer side of which is hinged to swing back, giving ready access to the wheel.

A range of motor-driven hand reamers also contain points of very considerable interest. They are designed with a view to their use in shipyards and are, therefore, made exceedingly compact. For use in awkward corners and other rather inaccessible places, the support arm is detachable. The driving motor, which is enclosed, is ventilated by a fan, and has drip-proof covers, and, the windings being insulated with material impervious to moisture, the tool can be used in any weather. A tool bit "knock out" arrangement is comprised in the spindle. The spindle is built in alongside the motor to economise space, and the whole machine is of strong, rugged design, suitable for the rough service it is likely to meet in shipyards and repair shops. The smallest size has a capacity for reaming up to $\frac{5}{16}$in. in diameter and

FIG. 46—TWO-SPINDLE BUFFER—BLACK AND DECKER

drilling $\frac{7}{8}$in. At no load the speed is 350 r.p.m., and the total weight is 26 lb. The largest size can accommodate drills up to 2in. in diameter, has a weight of 56 lb., and runs at a speed of 175 r.p.m. at no load.

J. B. STONE AND CO., LTD.

The nibbling machine made by J. B. Stone, of 135, Finsbury-pavement, London, E.C. 2, is familiar to many of our readers, but there are two advances in the machines exhibited this year. These machines are, of course, intended for cutting out sheet metal to complicated patterns, and act by punching, or shearing, off a series of crescent-shaped pieces with a circular punch. It is assured that the cut shall be a crescent, and not a full circle, by a peg which protrudes below the cutting edge of the punch, so that, as the work is fed forward, the peg limits the depth of the bite which the punch makes. In this way, a much smoother cut is made than is possible with the old system of drilling adjacent holes. The punch is operated by a fast-running excentric at the end of an overhanging arm, and high cutting speeds are attained.

A new machine exhibited this year is capable of cutting steel plate up to $\frac{1}{4}$in. thick, while a new form of punch, which has just been evolved, is capable of making clean cuts in stainless steel without losing its edge unreasonably quickly. The same firm is exhibiting a number of styles of belt fasteners.

DAVEY, PAXMAN AND CO., LTD.

On the stand of Davey, Paxman and Co., Ltd., of Colchester and Aldwych House, London, W.C. 2, there is shown a six-cylinder totally enclosed heavy duty oil engine, designed to develop 300 B.H.P. when running at 600 r.p.m. The engine is exhibited direct coupled to a 200-kW D.C. Metropolitan-Vickers generator and shown running at about 550 r.p.m. to demonstrate the smoothness of operation.

The outstanding feature of the engine is the adoption of welded steel framing, under Stevens patents, which, it is claimed, has the advantage of considerably reducing the weight, while ensuring an engine frame of the maximum stiffness. Such a design is of particular importance for certain marine work and transport purposes, in which cases extreme rigidity together with low weight are essential. A noticeable feature of the design is that the combustion stresses are taken direct from the cylinder heads to the main bearings by continuous steel plates, one of which is placed between each pair of cylinders, as will be seen from Fig. 47. These steel plates are so arranged that they form a sling round the cylinder head plate and crank shaft seatings, and as no horizontal joints are used the makers claim that failure under severe tensile stress is eliminated. Fig. 48, together with Fig. 57 on page 296 and the drawing reproduced in Fig. 47, show views of the engine, from which it will be gathered that the whole steel framework forms a single unit, which is bored to receive the separate cylinder liners and crank shaft.

Extreme accessibility has been kept in mind, and the arrangement of the main framing is such that after removal of the large end bearing the piston and rod can be lowered into the crank bed and drawn out sideways, as illustrated in Fig. 49. This operation can be done without removing the cylinder head or disturbing any piping or valve gear, it only being

necessary to remove the atomiser and to insert a special slinging bolt. We ourselves have seen a piston taken out in less than ten minutes.

All the valves are carried in separate detachable cages and are operated by plain rockers with a simple adjustment. The whole of the valve gear, rockers and cam shaft bearings are furnished with forced lubrication and are enclosed by sliding covers, while the crank case doors are covered by extremely light detachable covers, which are secured by a special type of clip requiring the minimum time for removal.

The fuel injection system is on the Paxman standard lines, utilising the well-known patented "spring injection" principle adopted by the firm. The fuel measuring pumps, which run at half engine speed and supply a regular quantity of oil to the spring injection mechanism on the cylinder head, together with the governor, are separately driven from the two cam shafts.

Turning to the principal parts, it may be noted that the crank shaft is completely machined and is of exceptionally large diameter with massive webs.

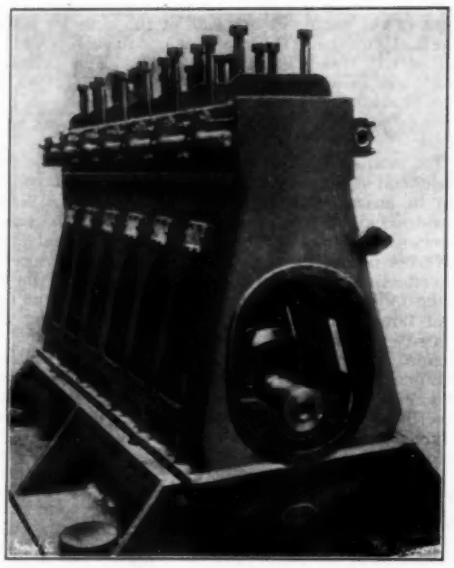


FIG. 48—END VIEW OF CRANK CASE—PAXMAN

The main and large end bearings are of gun-metal lined with special high tin base white metal, while the connecting-rods, which are of "H" section, are forged from special steel and machined all over.

A Hans Renold chain, which is enclosed in a casing, drives the central lay shaft at the fly-wheel end of the engine and from this the drive is taken by two spur gears to the two cam shafts situated on either side of the engine. Ready means of adjustment are provided for the chain drive. As will be seen from our illustration, both the air manifold and water-cooled exhaust manifold are carried above the engine and form the top supports for the flat sliding covers protecting the valve gear. These manifolds have been so designed that it is not necessary to disturb them should it be required to move the cylinder heads.

The lubricating oil pump is driven direct from the crank shaft through a "free-wheel" attachment which enables it to prime the oiling system. The oil is drawn from the storage tank and forced through a cooler on the main supply to the pressure system feeding the main bearings, large end bearings, small end bearings and pistons, while an independent low-pressure pump supplies oil to the cam shaft and valve gear from the cam shaft troughs. The new design is characterised by the small headroom required, and its low weight, and is suited for auxiliary duties on board ship where such engines can be installed between decks or in confined spaces. For continuous heavy duty the engines are arranged to operate at speeds up to 600 r.p.m., but for traction and similar duties they may be run up to 750 r.p.m. We shall refer to the Aveling and Porter exhibit on this stand in a later article.

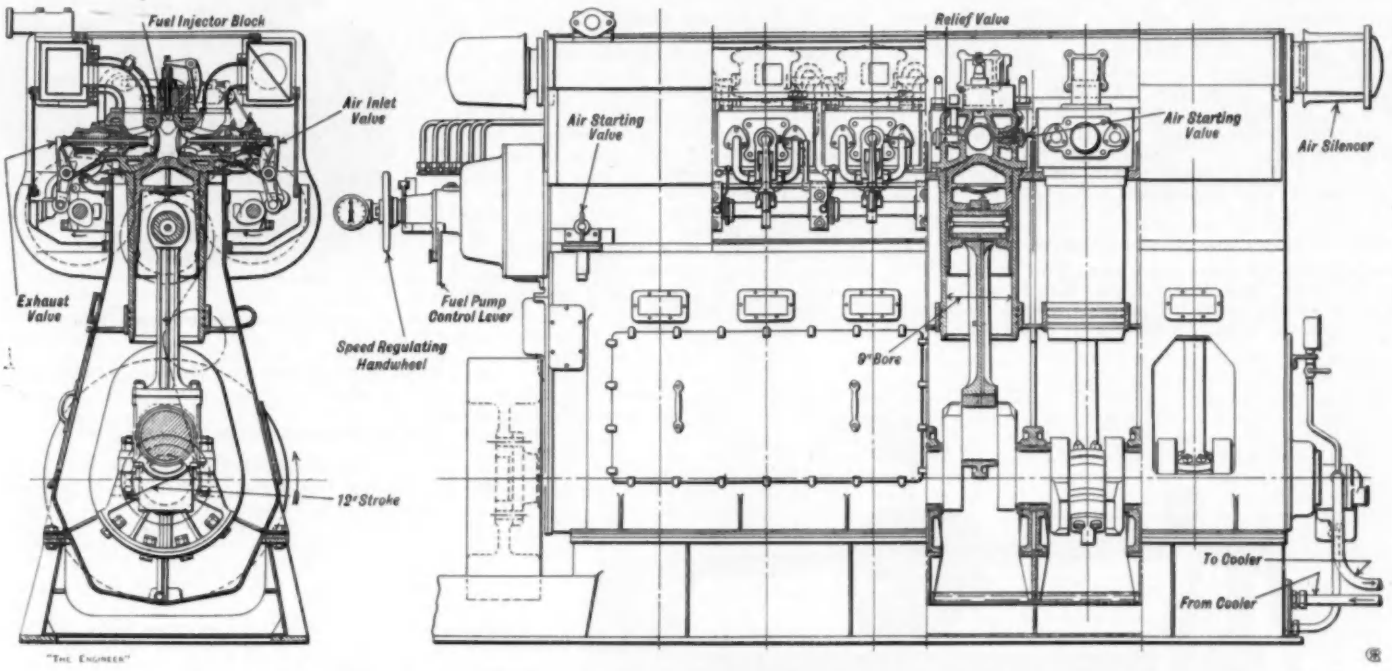


FIG. 47—LONGITUDINAL AND CROSS-SECTIONS OF 300 B.H.P. STEEL-FRAMED OIL ENGINE—DAVEY, PAXMAN

FIG. 49—METHOD OF REMOVING PISTON—PAXMAN

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LTD.

Among the large and varied display of products of Sir W. G. Armstrong, Whitworth and Co., Ltd., of Scotswood Works, Newcastle-upon-Tyne, we have chosen for particular description the 250 B.H.P. standard Armstrong-Sulzer locomotive type engine, see Fig. 56, page 296, which is one of a series of engines recently built and tested at the Scotswood works, three of which are to be installed in oil-electric rail-cars for British railway companies. It is a six-cylinder unit, with a 220 mm. bore and a 280 mm. stroke, and works on the four-stroke cycle. The cylinders are cast in one block to form a rigid longitudinal girder, which is supported on the light main frame made of steel. The engine is totally enclosed with inspection doors for the crank case, the push-rods, and the cylinder heads. The connecting-rods are made of chrome nickel steel, while the pistons, which are of the trunk type and are uncooled, are aluminium.

The engine operates with direct airless-injection of the fuel on the Sulzer pre-combustion chamber principle. This method of injection, it is claimed, has the advantage of requiring a comparatively low injection pressure and makes possible fairly large nozzle holes, both factors of importance when considering reliability of working.

Each cylinder has its own fuel pump, which is arranged between the push-rods of the inlet and exhaust valves, in which position it is accessible through the inspection doors provided. The pump is driven directly from the main cam shaft and is of simple and robust design. The quantity of fuel delivered by the pump is automatically adjusted to suit the required output of the engine by means of a centrifugal governor, which keeps the engine running at a constant speed. The fuel injection system is designed to give a high economy over a wide range of load and speed. The governor has three different speeds, which can be selected at will from the driver's control position in the cab of the rail-car.

The engine is started by means of the main generator, which, for this purpose, is connected to a storage battery, and, during the starting period, works as a motor. No starting receivers or air compressors are required. The engine can be stopped whenever the locomotive is coasting or standing in a station, and can be started again within a few seconds.

Under service conditions a circulating water pump is fitted which may be driven either direct from the engine or by an auxiliary motor, and this pump circulates water through the engine jackets, and through the radiators, which may be fitted either on the roof or elsewhere, according to the nature of the coach and its particular service.

The engine has been designed to work fully automatically as regards its fuel delivery, and its lubrication and cooling, while it is controlled entirely from the driver's position, so that no special attendant is required.

Other exhibits on this stand include a high-duty oil-fired Spencer-Hopwood boiler, which has a diameter of 4ft. 6in., a height of 11ft., and is designed for a working pressure of 120 lb. With cold feed its output is 1900 lb. to 2400 lb. of steam per hour. The oil burner is of the "Galva" type, and is lent by Kermodes, of Liverpool, with a Moorland Engineering Company feed pump, lent by that firm. The other exhibits include a wide range of melting furnaces and die-casting machines, most of which have previously been described in THE ENGINEER, and these, together with a display of pneumatic tool exhibits and special cast irons from Close Works Foundry, Gateshead, make a very complete exhibit.

PERMAN AND CO., LTD.

The main exhibit of Perman and Co., Ltd., of 82 to 83, Fenchurch-street, London, is the three-cylinder, 150 B.H.P. Kromhout cold-starting marine oil engine illustrated on page 296, Fig. 54, which is of particular interest, as it represents a type of prime mover installed on over twenty-five tugs and lighters now in operation on the Thames. It follows the makers' usual design as regards the main scantlings and the clutch and reverse gear, which parts are of a heavy type, specially designed for marine service.

The engine has a designed output of 150 B.H.P. at 320 r.p.m., and it has a bore of 125 mm. with a stroke of 175 mm. It is arranged for compressed air starting, the air compressor being mounted at the

clutch end of the engine on the bridge casting of the reverse gear. At this end of the engine there are also the interchangeable bilge and circulating pumps.

The governor fuel pumps and air-starting cams with their controls, are conveniently mounted at the end of the engine, opposite the clutch. The connecting-rod top ends are furnished with the patented Kromhout gudgeon pins, embodying a rolling contact on hardened surfaces, which, save for the avoidance of rust, do not, we are informed, require lubrication. The engine is provided with forced lubrication to all running parts, and the system includes an oil cooler, and duplex Auto-Klean strainers, all designed to work at a pressure of about 10 lb. per square inch. A visible return oil flow is also provided in the system. Other exhibits on the stand include small two-cylinder engines, each of 18 B.H.P. output for marine and for stationary duty, and a 7 B.H.P. single-cylinder marine engine. All the marine type engines are complete with the firm's standard clutch.

Siemens-Schuckert (Great Britain), Ltd.

The exhibits of Siemens-Schuckert (Great Britain), Ltd., of 30–34, New Bridge-street, E.C. 4, consist of electric welding machines, portable electric tools, and electrically driven pumps and compressors.

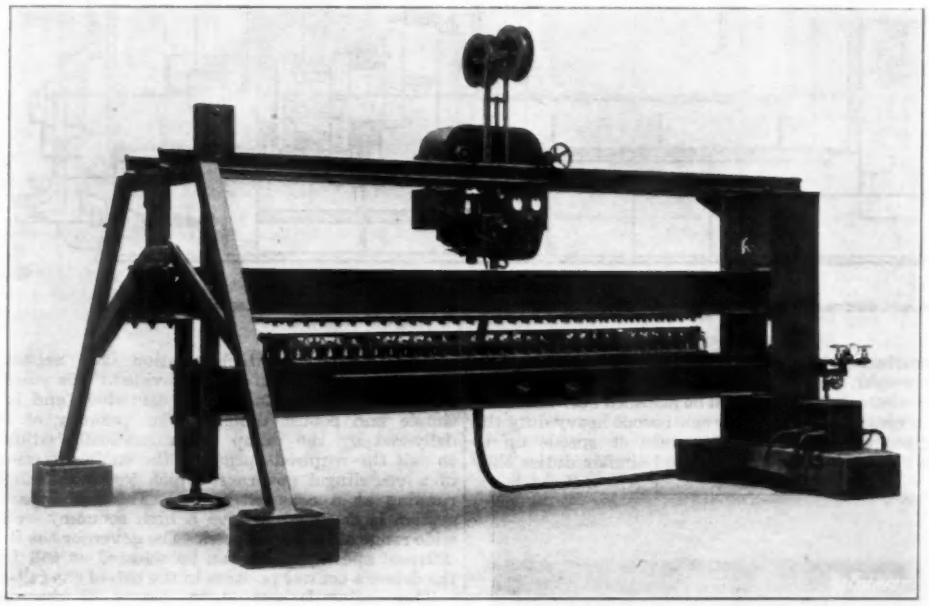


FIG. 50—AUTOMATIC WELDING MACHINE—SIEMENS-SCHUCKERT

Automatic carbon arc and metallic arc welding machines, shown in operation, are suitable for welding the longitudinal and circumferential seams of vessels, for welding square containers, and other articles, such as steel pressings, &c. For the operation of these machines skilled workmen are unnecessary, for all the operator has to do is to press a button when the arc is struck and the machine is started. A welding head travels along the seam of the work, or, alternatively, the work travels and the welding head remains stationary. At the end of the seam the operator depresses the stop button, and after the welding head has been returned to the starting position the machine is ready for making the next seam. The illustration, Fig. 50 shows an automatic machine for welding the longitudinal seams of round mild steel and stainless steel containers in sizes ranging from 2ft. to 10ft. in diameter, and from 3ft. to 10ft. long. The speed of welding depends on the shape, size and thickness of the work, and varies from 9in. to 3ft. per minute.

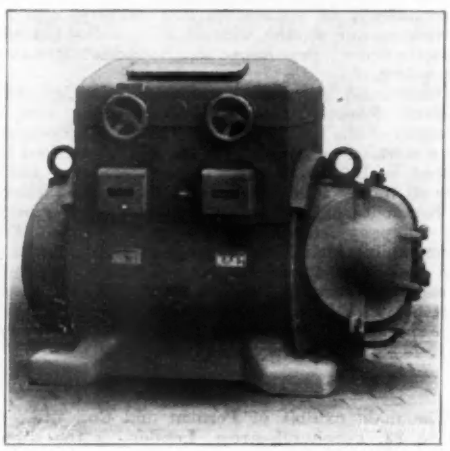


FIG. 51—ARC WELDING GENERATOR

The illustration, Fig. 51, shows a portable waterproof arc welding plant for D.C. welding, which can be set within the limits of its capacity for use with any make and size of bare wire or flux-coated electrodes, and for any thickness of material to be welded. The machine is self-exciting and no welding resistances or choke coils are employed. The arc is said to be stable under all conditions; it is claimed, in fact, that, owing to the extreme stability of the arc, it is possible to weld vertically or overhead with bare wire electrodes. This machine, like the automatic welder shown in Fig. 50, is to be seen in operation.

Spot and butt-welding machines and an electric rivet heater, fitted with a water tank for keeping the electrodes cool, are also exhibited. Although water-cooling is used in the firm's rivet heaters, the machines are portable and independent of the water supply. The portable electric tools exhibited consist of "Elmo" drilling machines—see Fig. 52—hand grinding machines, flexible shaft grinders, electric screw drivers, electric saws, filing machines, &c. The portable drilling machine shown in Fig. 52 is operated by means of a three-phase motor. Apart from the occasional lubrication of the bearings, the machine requires no attention.

Other exhibits consist of various sizes of the firm's "Elmo" self-priming centrifugal pumps for the supply of water to country houses, &c. These self-priming centrifugal pumps are designed on the same lines as the firm's "Elmo" water seal air pump, and, as will be seen from Fig. 53, a central casing, embodying the suction and delivery connections, is connected by a flange to one side of the pump, whilst the other side of this casing is connected to the motor, and, as the pump impellers are carried on the extended motor spindle, a coupling is unnecessary. Apart from the initial filling of the housing, priming is unnecessary, for, like the "Elmo" air pump, the machine is capable of dealing with air. The operation of the plant is not impaired by small leaks in the suction pipe, or a leaky foot valve, and is suitable for a suction up to approximately 24ft. It is also capable of pumping water with a small quantity of sand in suspension. As a temporary throttling of the delivery pipe does not cause an undue rise of pressure, the pump can be operated with the delivery pipe closed for short periods without fear of damage. A reduction of delivery head does not overload the motor, and it is unnecessary to close the delivery pipe when starting the pump. The "Elmo" vacuum pumps are suitable for producing medium and high vacua for various purposes, or compressed air free from oil. Among the advantages claimed for these pumps are small space for a given capacity, light foundations and small attention. The machines are coupled directly to a high-speed motor, and when used as air compressors the air is guaranteed to be free from oil.

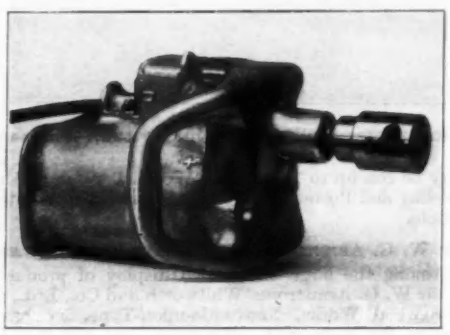


FIG. 52—PORTABLE ELECTRIC DRILL

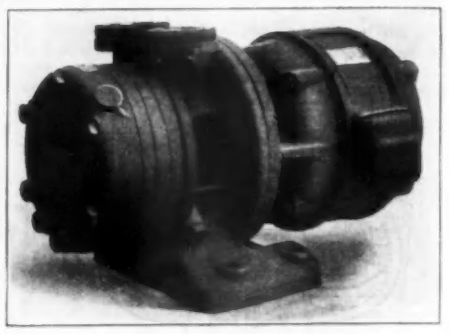


FIG. 53—SELF-PRIMING PUMP

The National Gas Engine Company, Ltd.

The engine exhibited by the National Gas Engine Company, Ltd., Ashton-under-Lyne, is the company's new six-cylinder unit which has been developed as an auxiliary for all classes of ship and is also applicable for the propulsion of small boats. The rated power is 150 B.H.P. at 600 r.p.m., with a bore of 7½in. and a stroke of 11in. The set—see Fig. 55 on page 296—is coupled directly to a 100-kW, 220-volt dynamo, by the General Electric Company, Ltd. The engine is built to Lloyd's specification and operates on the four-stroke cycle, starting up from cold on compressed air. The crank shaft is supported in large steel bearings lined with anti-friction metal, the bearings being carried in the main bed-plate casting. Holes are drilled through the crank shaft, and oil under pressure is pumped through to the crank shaft, the connecting-rod bearings and valve mechanism. The lubricating oil pump is fixed at the end of the crank shaft directly over the oil tank, which is secured to the base-plate, and it is provided with a device to allow the priming of the lubricating system before starting up the engine. The lubricating oil tank contains a large filter, which can easily be removed for cleaning purposes. The crank case and column casting is in one piece and it carries the loose cylinder liners, the cylinder heads being attached to the top of the column casting by studs. The air inlet and exhaust valves are set back slightly from the centre line of the cylinders, while the fuel valves are arranged at the front of the engine at one side of the cylinder head. The fuel pumps and the injectors, one to each cylinder, are of the Bosch standard pattern. The cylinder heads are provided with light removable covers of aluminium, and provision is made to inspect the running parts and main bearings through crank case doors.

The cam shaft is driven by spur wheels at the fly-wheel end of the engine, and the cams are arranged to dip in an oil bath, the cam shaft bearings being pressure fed. The cam shaft, together with the valve mechanism, is totally enclosed. A centrifugal type governor is mounted on the crank shaft and controls the effective portion of the fuel pump stroke, the oil being by-passed earlier or later in the stroke as the load falls or increases. The fuel and starting air controls are grouped at the governor end of the engine. All parts of the engine have been designed and manufactured so as to be completely interchangeable. In addition to the six-cylinder unit, we have described, similar engines with four and five cylinders having designed outputs of 100 and 125 B.H.P. respectively are also made.

(*To be continued.*)

The Institute of Metals.

No. I.

The annual autumn meeting of the Institute of Metals was held in Zurich from September 13th to 15th, at the invitation of the Swiss Association for Testing Materials. The opening meeting took place in the Federal Polytechnic on Sunday evening, September 13th, before a large and representative audience, under the chairmanship of the President, Dr. Richard Seligman.

The proceedings commenced by the Secretary reading the following list of names of members nominated by the Council to be balloted for in connection with the election of Council for 1932:—As President, Sir Henry Fowler; as Vice-Presidents, W. R. Barclay and Dr. H. Moore; as Members of Council, Maurice S. Gibb, R. Lloyd Gibbins, James

Steven, W. G. Turner, H. B. Weeks, and E. L. Morcom.

OFFICIAL WELCOME.

Colonel Messner, on behalf of the Swiss Association for Testing Materials and of the City and Canton of Zurich, extended a hearty welcome to the members on the occasion of the first meeting of the Institute of Metals to be held in Switzerland. Animated by the desire to encourage scientific collaboration for the furtherance of the aims of the Institute, the Swiss metal industry—Swiss scientific bodies as well as Swiss political authorities—were opening freely their doors and workshops to the members. He drew the members' attention to the fact that in his own small country of Switzerland everything would, of course, be on a scale small compared with that to which the members were used in the large cities and industrial towns of Great Britain and the Empire. Modesty in everything characterised Switzerland and its population; but if the members took things as they were he was convinced they would feel at home in Switzerland. The first Congress of the new International Association for Testing Materials had just finished. He had been told that the results had been very satisfactory, and he hoped that the present meeting of the Institute would be likewise successful in every respect, maintaining the traditional friendship which had always existed between Great Britain and Switzerland.

The President, in thanking the Swiss Association for its welcome, laid stress on the fact that its great object was to combine science, technique and industry, not only in the interests of its own members and country, but in order to promote a friendly understanding amongst all the nations of the world. That object was very similar to that of the Institute of Metals, whose members felt, therefore, that in coming to Switzerland they did not come as strangers to a foreign land, but as brothers to brothers, being assured of a friendly reception and feeling that, by their coming, they were forging new bonds between the fifteen or sixteen nationalities which were represented in the meeting that night.

Mr. W. B. Price, as the official representative of the American Institute of Mining and Metallurgy, expressed his pleasure at being present to renew old acquaintanceships and to make new friends. His Institute, he said, was looking forward to the visit of the Institute of Metals to America in 1932, and its members would do their utmost to make the visit enjoyable and profitable.

Dr. G. Masing then added a few words as representing the Dutch Society for Testing Materials. In Holland there were no factories which produced any non-ferrous materials, and there were only a few which made products from those metals as the main object of their output. As a consequence they had to look to other countries for information on the subject, and one of the Associations to which they were most indebted was the Institute of Metals, through the information and help given in its "Transactions."

The representative of H.M. Britannic Government, Sir Henry Fowler, also addressed the meeting. He said the fact that he had been asked to represent H.M. Government at the meeting was an indication that H.M. Government did appreciate to a certain extent that an institution such as the Institute of Metals was a great asset to any country. From his conversations with those who dealt with the scientific work for the Government he knew how they appreciated the great work which was being done by the Institute of Metals.

AUTUMN LECTURE.

The tenth autumn lecture of the Institute was then delivered.

The President, in introducing the lecturer, Mr. Ulick R. Evans, pointed out that he was a member of that great fraternity known as the University of Cambridge, and in that fact he thought the members were particularly fortunate, because there still lingered in many parts of the Continent the idea that our two great historic universities devoted the whole of their time exclusively to the study of dead languages, interrupting these studies once a year in order to row a boat race one against the other. Such an idea as that was utterly out of date. He need only recall such great scientific names as Thompson or Rutherford, or, to come more closely to the Institute's own subject, Heycock and Rosenhain. They of the Institute felt that Evans very worthily upheld the traditions which those great names recalled; he had worked successfully in many branches of science and of chemistry and physics, but had made the subject of corrosion a field entirely his own—a subject on which he was about to address the members that night.

THIN FILMS AND CORROSION.

The author said that to discuss corrosion in Zürich was appropriate. First because the cleanliness of the industrial quarter of Zürich afforded support for the view that a foul, corrosive atmosphere was not the necessary accompaniment of industry; and, secondly, because very important researches on the subject had been carried out in Zürich by von Würtemberger, Honegger, Köhlschütter, and others. Continuing, he said the oxide films, which are responsible for the apparent stability of such metals as aluminium and stainless steel, are usually too thin to give interference tints; they are invisible whilst in contact with the metallic basis, but are perfectly visible when removed from it. Although the films produced by air alone give some protection, the stability can be increased by special treatment with oxidising agents. The slightly thicker films produced on heating in air give rise to beautiful interference tints, such as the temper colours on iron; but they tend to crack and have usually little protective value.

Almost all methods of removing a film—whether an "invisible" film or a film thick enough to produce an interference tint—depend on some treatment which will dissolve the metal immediately below, thus allowing the film to peel off. For films on aluminium, nitric acid, or gaseous hydrogen, chloride has been used. For iron, a solution of iodine; for other metals, anodic treatment in a chloride or sulphate solution. It is sometimes possible to transfer the film to glass or cellophane, and the films responsible for heat tints often show tints even after removal to the transparent support.

Although certain additions to metals, especially those which pass into solid solution, increase the resistance, impurities present as a second phase often increase the tendency for a breakdown of the film to extend, thus increasing the total destruction although sometimes rendering the attack less localised, and hence less intense.

Most natural oxide films are not wholly impervious to ions; they contain weak points. To be useful, they must be "self-healing." In other words, the secondary corrosion product must be precipitated so close to the weak points in the film as automatically to seal the defect. The movement of electrode potential with time provides a valuable method of observing whether, in any particular case, the weak points are healing up or are extending. Such methods have been used to demonstrate the self-healing qualities of the film present on the new brass containing aluminium, which is now being used with success for condenser tubes. They can also be applied to the comparison of various steels containing chromium and/or nickel, under different conditions of heat treatment and surface treatment. A corrosion product can only be protective, if produced very close to the metal. Lead resists a sulphate solution, but not a nitrate solution. Galvanised iron resists small drops of salt water better than large drops. When part of the surface of an immersed metallic specimen is "screened" from oxygen, any weak points on the screened area will tend to develop, whilst on the "well-aerated" part they will tend to heal up. Foreign bodies lodging in condenser tubes often cause local attack, probably as a result of their screening action. When the concentration of oxygen—or oxidising agent—remains fairly uniform, the water line is the weakest place. An aluminium sheet introduced vertically into a chloride solution is mainly attacked along the water line and at the cut edges. When metal is continually bent or abraded or bombarded by air bubbles, whilst in contact with a corrosive solution, the mechanical erosion will often prevent self-heating, and corrosion will then continue. Likewise, the combination of alternating stresses and corrosive influences causes damage far more rapidly than either alternating stresses or corrosive influences acting alone. Such cases cannot be explained on purely mechanical or purely chemical principles. Both influences must be taken into consideration. Consequently, a greater collaboration between the engineer and the chemist is called for than has been obtained hitherto.

Dr. C. A. Benedicks, in proposing a vote of thanks to Mr. Evans for his lecture, remarked that the first natural philosopher to express the assumption of an invisible film as a protector had been Faraday. Faraday had assumed the occurrence of a thin film to be the cause of passivity; he did not say that it was an oxide film, but merely said, as the sharp and true scientific philosopher he was, that it was an oxygen-containing film. The long discussions which had taken place in explanation of passivity by this film theory and the assumption of more or less complicated chemical factors had now been definitely settled. Mr. Evans had made the invisible film visible, and had taken the intangible film between his skilful fingers.

Dr. von Würtemberger, in seconding the vote of thanks, pointed out how fruitful Mr. Evans' work had been in the domain of corrosion research. Formerly it used to be stated as an introduction to every article on corrosion how extremely complicated the problem was, and then to show some ways to make it still more complicated. That night Mr. Evans had stated exactly in what way some or other corrosion process was proceeding, which laws were governing it, and what means were available eventually to avoid damage. Mr. Evans and himself had met years ago in the conception that the whole of corrosion phenomena, in spite of the fact that they appeared to the outsider as occurring irregularly, did follow certain laws; that was to say, electrochemical laws. Further, that the destroying forces which occurred with local corrosion were not to be sought for in unhomogeneities of the material, but in a disturbance of the equilibrium of potentials on the surface. The consequences resulting from this were therefore that if a certain spot was particularly attacked the cause was not a specific weakness of the said spot, but the electrolytic nobler character of the surrounding surfaces. The views formed at the time were still valid. Mr. Evans showed that oxygen potential was to be considered as one of the chief cathodical factors, and he continued to observe the secret games of ions, atoms and molecules in the boundary region between metals and liquids, and to throw light on them. He recorded those occurrences as if he had been personally present, and as a matter of fact he had been present, thanks to his scientific intuition and to present-day highly developed research methods.

Mr. Evans and his collaborators had studied one special range of the problem after another. To-day metallurgists need no more discuss the hypothesis of film absorption layers. In practically all important cases the oxide skin had now been isolated. With the oxide films matters were fairly clear to-day. With reference to the sulphide films, the difficulties connected with them had persuaded him (Dr. Würtemburger) of the impossibility of finding a solution for certain protection problems, and he could only hope that Mr. Evans would bring light to bear on to those details also. Up to the present there appeared to be little hope of useful protecting self-healing films forming in that case.

Mr. Evans had referred to the financial extent of the corrosion problem, and had laid stress on the necessity of educating engineers better in the chemical branch. Personally, he wished to support that suggestion. It was there that corrosion problems were often not dealt with in that thorough manner which they merited. From the engineer's point of view, corrosion was sometimes looked upon as the factor which relieved him from responsibility; and, for the normal chemist, corrosion problems were generally not chemically pure enough. There was no denying the fact that science and technique needed specialists who were naturally talented and interested chiefly in one point of view.

The whole work of Mr. Evans distinctly proved that only after attacking practical problems in a thorough systematic and detailed manner, applying all the means known to science, satisfactory results could be obtained. Colleges should offer to people whose interest and capacities pointed in this direction the opportunity of specialising in this branch, and industry should recognise that the normal procedure of testing material was no longer sufficient, but that a consulting staff was required, which would act as a specialised intermediary between the wishes of design and calculation, the possibilities of supply of material, and manufacturing. At least one-third of the education of such a material specialist would be devoted to corrosion and wear and tear problems. Why should it not be possible to arrive at a sort of rationalisation—perhaps by agreement between certain universities, whereby opportunities would be offered to students of that science to study the various branches in those institutes of learning which were already teaching one or other of those special branches? Personally, he imagined that by studying general engineering for some time in Zurich, and then chemistry and metallurgy at a university in a specific metallurgical region, a very valuable and complete education would be obtained. He believed that would be a proper way to arrive at an economical use of natural and industrial products, and would help towards a mutual understanding between producers and consumers. It should be remembered that all their products, the manufacturing of which meant the daily bread of many people and the acquiring of which was a cultural necessity for others, were primarily materials which had to be worked and refined through much expensive labour. Proper manufacturing was based on a correct and approved choice of the material, and not only on a purchasing system, which in case of failure tried to throw the responsibility on the supplier.

The period of development of our world economics which was based upon extreme progress and success in smaller and larger sub-branches, without considering the damage and hindrances which might be caused to others, had come to a regrettable state. It was to be hoped that a really healthy economic state of affairs might be arrived at.

Among the factors necessary for the recovery from the present troubles there should not be neglected the continuation of useful thorough research work in special branches of science, an example of which was seen in the work of Mr. Evans, and the application of such work in the industry through properly educated specialists. That important work was traditionally reserved to the technical universities and was only waiting to be taken in hand.

The vote of thanks was carried with acclamation, and the meeting adjourned till the following day.

(To be continued.)

SILICA or silica dioxide (SiO_2), either free or in combination with other elements, constitutes 59·08 per cent. of the lithosphere, and quartz alone represents fully 12 per cent. of all rocks. Next to the feldspar group quartz is the most abundant mineral in the earth's crust, and it appears in a greater number of varieties and modes of occurrence than any other mineral. Silica or quartz occurs in crystalline, cryptocrystalline, microcrystalline, and amorphous forms. The most common, however, is the crystalline form, which occurs as three minerals: quartz, tridymite, and crystobalite, and of these three tridymite and crystobalite are quite rare in Nature.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. VI.—PROCESSION TOOLS.*

SECTION III.—PROCESSION TOOL DESIGN.

In the first section of these articles on procession tools I indicated that there is a principle upon which it will be possible to say whether a piece definitely can be produced complete in the one operation. Whether tools for such operations can be made within the limits of size imposed by the presses at the disposal of the particular designer is, of course, another question, as is also any special point with regard to the type of material used. Blanks from certain materials, *e.g.*, spring steel, should, when possible, be taken from the metal so that the bending strain on the finished spring is longitudinal with the original bar grain and not transverse to the grain, and special feed requirements of this sort may debar the part from single operation production that otherwise might be handled satisfactorily on this principle.

Plain, straightforward pierced and blanked work presents no difficulty to the design of single operation tools so long as the designer obtains the maximum amount of strength between the various holes in the die or die blocks. On the other hand, pierced and cut-off work may not be quite so simple, since no scrap is allowed for between the finished parts. From this point of view it is almost essential that in work on the thicker sections of material definite allowance is made for the expansion of the metal, and the need for this in pierce and blank tools, though not perhaps quite so apparent as in pierce and cut-off tools, is nevertheless strongly advisable both from the point of view of accuracy of the finished blank and the saving in material effected by the utilisation of the expansion of the metal.

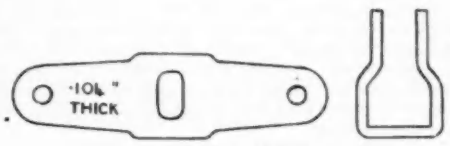
Work involving bending processes in addition to piercing is a different proposition, and it is to this class of work that I propose to devote my attention in this section. It is difficult to lay down hard-and-fast rules for design on account of the great multiplicity of finished shapes produced by presswork, but I find it reasonably easy to decide on a mode of production by careful consideration of the finished part, the various bends, possible directions of feed for the bar and any other points of especial interest in the part itself. Of these points for consideration the most important in my estimation is bending. I cannot say definitely, but I believe that the previous part of these articles—"Bending Tools"—covers the majority of principles applicable to press tool work, and any bend in the part to be produced should be capable of handling on one of these principles. Unless it is possible to put in the various bends at the last stage, as in the tools illustrated in Figs. 38 to 40, the tools must either be capable of such design as to allow free passage of the bent parts or the bends must be put in the blank so that the line of the bend is longitudinal to the feed direction and not transverse, as in the tools instanced above. Another point of great importance with regard to bends is that no part of the material to be moved by bending can be connected to the bar stock or the adjacent blank if the bending line is longitudinal to the feed direction. That is to say, that, apart from the slight rise to the stripper pad of the earlier stages of the tools, one point in the metal bar must pass in a direct and horizontal line along the stages from the first stage to at least the position for operation on the final stage.

Having decided that the various bends can be carried out and the ease of feed maintained, it is necessary to decide on some definite method of connecting the direct horizontal line point of the blank to the bar stock which imparts the direct horizontal line feed over the various stages of the tools. This can frequently be done by incomplete blanking, as instanced in the paragraph in the first section on procession tools, where reference is made to the part A′ illustrated in Fig. 34, and the completion of the shape can be either a simple cut-off operation on the one side of the blank only, or it can be, where necessary, a cut-off operation operating on both leading and following edges. Another very simple way of maintaining the material line feed is to connect the blanks by a small bar along the line feed and cut this bar out at the last stage, leaving the finished pressing on the surface of the die.

On the two foregoing points—bends and feed line—depend the practicability of single operation production, and if I have succeeded in making my explanations sufficiently clear no difficulty should be experienced in deciding immediately whether it is possible to produce any given part on straightforward single operation tools. Ingenuity can, of course, do far more in such work, or rather, it has less restrictions; but the recognition of certain essential principles of design will do much to reduce the apparent complexity of the various processes carried out. With the reduction in complexity a greater number of single operation tools can be considered, and although the first cost of a multiple-stage die may be in excess of that of a similar number of simple tools, the majority of the excess will be found to be due to the accurate location of the stages on the base-plate, and this is in effect the permanent setting of a number of pairs of tools. After the tools are completed the saving in setting time alone will in many cases more than pay for the extra cost in the first place and the saving in operation time and machine overhead costs will be net gain.

Having decided that the two main requirements for single operation tools are fulfilled, the various stages can be considered and, generally speaking, they can be roughly mapped out by laying out a number of stages on a piece of stiff card, roughly sketching the final blank shape in each stage, and, after completing the shape and form of the finished part at one end of the card by cutting and bending, the working scheme of the die can be rapidly planned out, following the stages back in a similar manner from the last stage to the first.

To illustrate my point I would refer to the blank sketched out in Figs. 17 and 18 of the article on "Bending Tools," Section 5. Actually it is not



FIGS. 17 AND 18 (*Reproduced*)

desirable to produce this piece in one blow, as the same blank is, for different products, bent to three different shapes, none of which would show sufficient saving in single operation work to warrant the outlay on a further pair of pierce and blank tools. All the same, it will serve as a simple instance of the routine involved in the design of a set of tools for the purpose.

Firstly, we know that the material has no definite drawbacks, that it can be fed or bent in either direction. Ingenuity could, if necessary, produce this part blanked longitudinally and bent with the bending lines transverse to the bar; but routine design points to the opposite direction, so that the bending lines are longitudinal to the feed direction, the blank length being transverse to the bar length. Consideration of the finished part shows at a glance that the feed point line must pass through the elongated hole in the centre of the blank and that therefore the final stage must consist of cutting or blanking the main bar through this line to sever the finished part.

The next consideration is the bend immediately before the final cut-off stage. The base of the complete pressing must remain stationary on the surface of the die, and it is obvious at a glance that it is impossible to carry out all the bends on the same stage and on the same principle utilised in the tools described as bending this part. Recourse must therefore be had to carrying out the bends at two stages of which the inward bends are the later stage, a downward U-shape bend being the first process from the flat shape. As far as the inward bend stage is concerned, this can be satisfactorily carried by two horizontal slides driven by 45 deg. angle punches, the inside form punch being mounted on the die, a flattening pad for the flat base of the bent blank being carried on the punch plate and operating at the bottom of the stroke. The U-bend stage presents a little more difficulty on account of the pressure pad required to prevent distortion of the hole during bending. If the base of the U bend were wider it might have been possible to eliminate the need for a pressure pad at this stage by piercing the hole at the same stage at the bottom of the stroke, and though this might be managed even in the present case, an indication of another method may be of value. An extremely long locating punch can be fitted for this hole at this stage, fitted with a spring and deep sliding collar, the face of which will cover the stationary portion of the stage blank. Positive pressure may be imparted by the bending punch to this collar at the bottom of the stroke to produce the necessary final squeeze and, the gap between form punch and pressure pad referred to in the article on the tools bending these parts, may be maintained at a fixed maximum by lipping a step-cut edge of this locating punch collar pad under a similar step cut in the underside of the stripper plate for the previous stage. If desired, this collar pad can be made in the form of an extended stripper, not connected with the punch in any way, but extended from the step cut under the stripper plate of the preceding die, over the bending-in die, after which it could split into a fork and open outwards to allow the blanking punch to pass on the final stage, the ends of the fork being hinged on suitable uprights on the base-plate.

Immediately prior to the U-bend stage would come the first two working stages of piercing and shaping of the outer edge of the blank. The order in which these two stages occur is immaterial, as is also the method of shaping the outer edge of the blank, *i.e.*, blanking by cutting the two wings, leaving a web of stock around each wing, or cutting away that material that would otherwise form a web. In the present instance I should be inclined to favour the latter course, on account of the facilities that it would offer for a final material stop for feeding, as will be seen later.

Having obtained the operation of each stage and having the whole main scheme clearly in mind, the normal detail can be proceeded with without any further delay. If the expansion of the metal is likely to prove of any account—as it would in this instance—provision should be made for die location adjustment, and in view of the shortness of the blank feed length, this can best be done by allowing for dummy stages between each working stage.

The essential lay-out of the main die block—composite or otherwise—for the production of this part can be gathered from Fig. 43, which shows a material bar end in position ready for operation. Equally divided between stages 1 and 2 are the outer shaping punches A, the holes in the die being shown dotted under the bar stock. Stage 3, after the half dummy stage 2, pierces the two wing holes at B and the centre hole at C. Stage 4 is a dummy stage, but shows clearly what has been accomplished on the preceding stages. At stage 5 the wings are to be bent down U shape over the edges of the die at D, being located from the centre hole at C and the finished shape from this stage is shown in the adjoining dummy stage 6. At stage 7 the wing ends are bent inwards by the slides previously referred to, but not shown, up to the

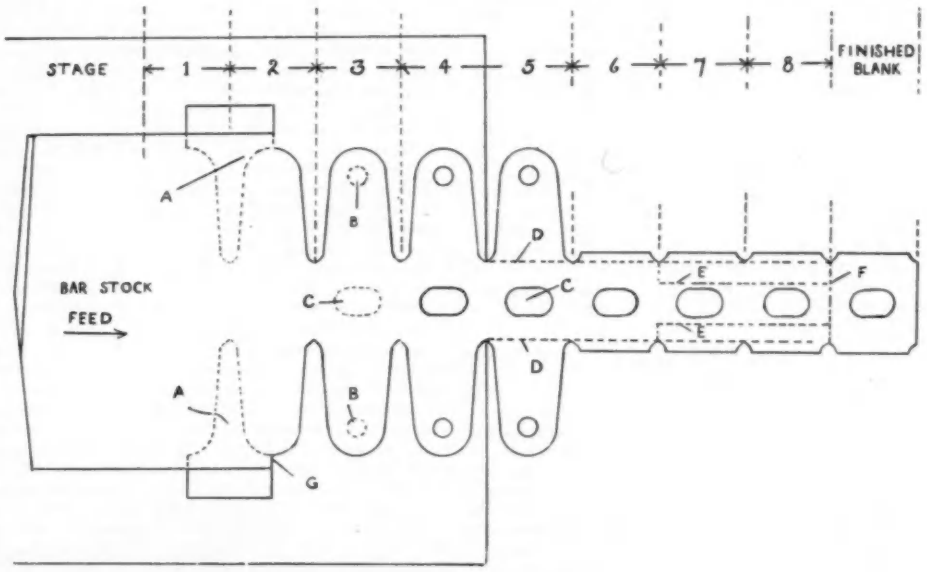


FIG. 43

reduced measurement of the under part of the die, as shown dotted at E, and the completed shape can pass over a further dummy stage till it is cut off the main bar on the end of the die at F. In production it might be found to be possible to close the punches A and punches B and C one complete stage and to eliminate at any rate dummy stages 6 and 8, even if stage 4 had to be maintained so that the overall length of the tools could be considerably reduced. Nevertheless, in my opinion, such reductions should be entered upon only after very considerable thought, as the difficulty of adjustment for stock expansion would be made rather precarious by undue elimination of dummy stages. The material can be gauged from the final stage bent blank if desired, but this would necessitate a series of finger stops for starting the bar and this can be eliminated by having the final stop operating on the first stage. If it is desired to reverse the system of blanking shown, *i.e.*, cutting all round and slightly bending downwards each wing, it will be necessary to reverse the first two stages in order to provide holes in the stock on which automatic peg stops can operate, but by employing the method sketched out the much simpler method of a fixed

* No. V. appeared September 11th.

material stop can be employed operating on the shoulder of the stock on one or both sides at G.

SECTION IV.—PROCESSION TOOL DESIGN (ii.).

In the opening article of this part, Fig. 32 showed a part that can be produced in a single operation, but which is clearly a more difficult proposition to tackle than that sketched out in the last section. I cannot say that I know the actual dimensions and exact shape of the part, and I have no idea of its functions. I merely remember it as being advertised some years back as a single operation production, and the main features of shape impressed themselves on me for the simple reason that I used the sketch to test out the principles of design, as set out in the previous section.

In the piece, as shown in Fig. 32, there are one or two points that presented difficulties not previously

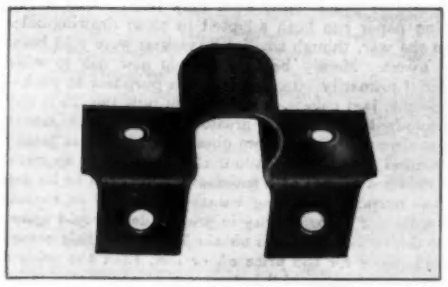


FIG. 32 (*Reproduced*)

described. The most important of these difficulties was the fact that the lines of the two sets of bends were at right angles to each other, so that in any case one set of bends must be transverse to the feed line. The next item of importance was the embossed holes at the ends of the main bar of the pressing, and, lastly but by no means least, came the question of connecting the pressing to the main bar through the various stages. Of these three main difficulties, two had to be taken together, that of the direction and position of the feed line was of paramount importance in the decision of the bar connection. To arrive at a sound decision on the question, it was necessary to utilise the process of elimination, and to that end I roughly sketched out the finished flat blank, as it would be if the bends were the last three or two separate operations of multi-operation production. This blank is shown at Fig. 44. Two holes E are pierced in the

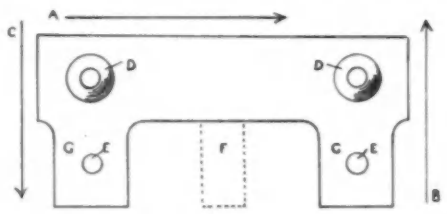


FIG. 44

blank ears G, while the two embossed holes are shown at D. Three directions of feed were possible, A and its reverse being for feed purposes the same. Feeding in the direction shown by the arrow A would make the connection of blank to bar a very simple matter, but to do this the ears G would have to be bent at right angles to the main bar surface prior to the last operation, which would have to incorporate rockers in the die or punch to carry out the C-shape bend in the main bar of the pressing. If such rockers were in the punch, some special mode of support would be required for the one which had to carry out the cutting-off process, in addition to its bending function, while, if the rockers were in the die, other difficulties of equal importance arose with regard to their level. In any case, the last stage was threatening to become hopelessly complicated, since the line of the bend, being transverse to the feed line, would prevent any motion further in direction of the feed line, and consequently the part had to be finished at that stage. While not admitting that ingenuity could not overcome the difficulties in this feed direction, attention was turned to the remaining directions to see if the ideal of simplicity could be achieved. Imagining a bar being fed in this direction, it was obvious that the reduction of the overall width left the centre of the main bar of the pressing as the only point that could be fed in a direct line from a plan view, and that therefore the feed line, if any could be found, must pass directly through the centre of the bar. This necessitated the provision of the connecting bar shown dotted at F. So far, both of the directions B and C were essentially the same, but the bending of the ears G at right angles to the main bar surface produced a balance of simplicity definitely in favour of the direction C. As before stated, bending lines transverse to the feed line must be handled in the final stage, and consequently the C-shape bend had to be executed prior to the final stage. From this it followed that as F must follow a straight line horizontally, and since the C-shape could not strip from the form punch in a vertical direction, the form punch must be located on the die shoe. If the form punch had to be located on the die shoe, the ears G had to be bent downwards from the main bar over an edge on the die, and if, as in the B direction, the ears were situated on the following edge of the blank, their bending over the die edge would prevent further motion of the blank in the feed direction, the bar F would have to be cut away in the same stage and the part removed from the tools in a two-direction motion of the operator's hand. On the other hand, direction C allowed free motion of the blank after bending, and by careful design of the die cutting off the leading edge of the bar F, it was clear that the blank could be in such a position that it would overbalance

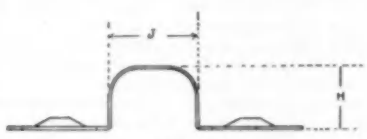


FIG. 45

and fall from the die on cutting free. Alternatively, it could be carried on the bar to a convenient stage, where it could be severed from the bar and passed through a hole in the die shoe, leaving the short bar F on the surface of the die. Bearing all these points in mind, the obvious feed direction was that shown by the arrow at C.

The blank was sketched and cut out in strong card, leaving a piece to correspond with the bar at F, and a dozen stages were traced out with this rough template on another piece of card. The original template then had the connecting bar removed and was bent to the final shape; by cutting and bending the stage card the various processes were traced back to

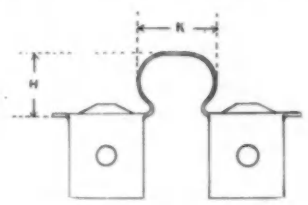


FIG. 46

the plain bar stock, as illustrated in plan view in Fig. 47, and completed by positioning the finished piece immediately following stage 5, as shown.

The first thing that should be noted is that as far as the bending stages are concerned—stages 3, 4, and 5—the dies would be of sufficient length to allow of separate anchorage in place of the block anchorage described in Section II., and this separate anchorage can be carried out by means of suitable bolts in slotted holes for adjustment on account of any expansion of the metal that may occur, and dowel holes provided for pins to the die shoe after final location of the stages. The next point is that, although it is shown as a five-stage die, a reasonable display of design could reduce it comfortably to a three-stage die and with the greatest of ease to a four-stage, but of this more later.

The finished part is severed after having passed through stage 5, consequently stage 5 consists of a suitable punch and dies—a continuation of the bending form punch—to remove the short connecting bar. There is no point in carrying out the G ear bend process at an earlier stage, so that this also can be done at stage 5 on the principle of the tools illustrated in Section I., Fig. 37. This leaves us with the sole problem of producing the C-shape bend while maintaining the bar F at the same height through the stages, and allowing for the awkward position of the embossed holes D. Here again the design is mainly a process of elimination, if rocking punches are temporarily ruled out for a single operation bend on account of the support necessary for shearing we are left with a two-stage bend, stage 3 being a simple draw bend, stage 4 being a pull-in slide or rocker bend. Of the two choices for stage 4 I should be inclined to adopt the slide bend with slides set at an angle to the surface of the die to enable an unbroken line for the bending edge to be provided without catching the embossed holes—see Fig. 46. Nevertheless, rocking punches could complete the bend quite as satisfactorily. Reference should now be made to the two illustrations Figs. 45 and 46, and it should be borne in mind that the top centre of the C-shape bend constitutes the feed line and that therefore it must remain at the same height through the stages. Furthermore, to keep the ends of the main bar of the blank horizontal when completed, the measurement H should be the same through all the bending stages; consequently the plain U-shape draw bend in Fig. 45 must be of a width at J greater than that of the bend in Fig. 46 at K by an amount sufficient only to allow the C-shape to be completed with the same lower bending line. The U-bend punch also has to act as a shear punch for the ears G from the main bar of the material. In stages 3 and 4 in Fig. 47 the positions of the material are shown before and after operation, as is also stage 5 and a part of stage 1. Stage 1 would pierce the two holes in the main bar, remove the two large square holes and crop the two side pieces away while stage 2 would only emboss the two holes pierced in the previous stage and pierce the two ear holes.

To reduce the lay-out of the tools to a three-stage die it would be necessary to revert to the B direction of feed. Stage 3, resulting in the finished piece, would carry out the bending of the ears, the embossing of the holes, and the shearing away of the piece connecting the stages. To maintain the level feed of the end of the bar it might be necessary to operate the embossing process by mounting the male embossing die on the die shoe on a rocking member operated by the punch pad, lifting the male die as the punch pad descended. By giving temporary support by extending the stripper pad on stage 1 to include the shear punches of stage 2 until final feed adjustments had been completed and permanent punch supports let into the die shoe, it would be possible to utilise a rocking punch shear and bend principle for the C-shape bend at stage 2, and the die would be sufficiently strong to allow of the four small round holes and the two square holes being pierced and the two sides cropped in stage 1.

In the five-stage process illustrated the final stop for the material would be situated on each side at the end of stage 3 and operating on the outer corners of the two ears. In a three-stage die the stop would operate on the end of the second stage on the same principle.

From the foregoing it should be apparent that large numbers of parts in multi-operation production at the moment can easily be produced at a single operation process providing a little thought is given to the necessary stages. The simpler the stages the simpler the tools, the first cost and the upkeep will be correspondingly less, while results should be the same if not better, than those tools employing more intricate stages. One of the chief obstacles is the reviewing, re-consideration and tracing of jobs that are not done on this principle simply because it has never occurred to the designer that they might be

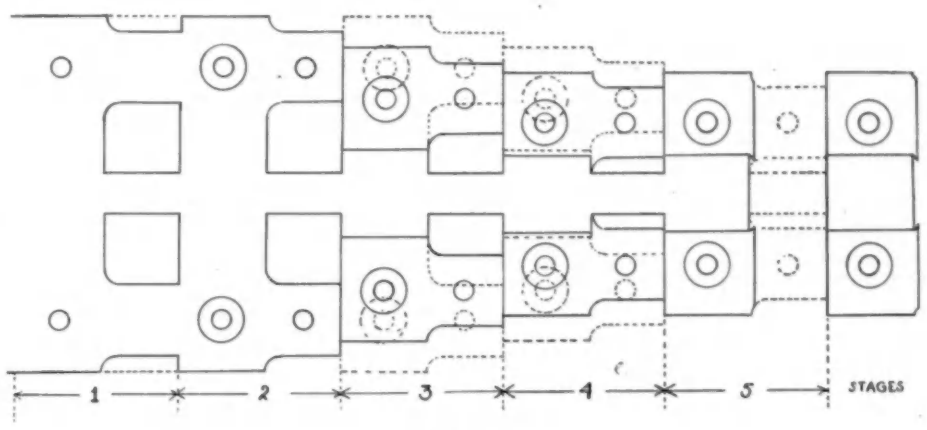


FIG. 47

"done in one." It is perhaps advisable to go to the other extreme and consider every job as a possible single operation job until proved to the contrary or forceful reasons are forthcoming as to the advantages of multi-operation production in that particular case.

(To be continued.)

A NUMBER of inquiries have been received by the Department of Overseas Trade from firms contemplating taking space in the trade ship s.s. "British Exhibitor." It is notified, therefore, that all such inquiries should be addressed to the organisers, as follows:—The Secretary, The British National Exhibition Ship, Ltd., Bush House, Aldwych, London, W.C. 1.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAILWAY IMPROVEMENTS.

SIR,—There is a widespread impression that something is wrong with the railways, but there is also a lot of vagueness as to what is wrong, and as a result many remedies have been proposed which would not remove the defects, even if they were applied.

Universal electrification at the staggering cost of £261,000,000 is a stupendous suggestion which was eagerly snatched at, but the Weir report contains two striking statements which have not been given their due weight. The report states first that the estimate of the capital cost of the works may prove inadequate, and, secondly, that the risks involved in undertaking a comprehensive programme—of electrification—cannot be predicted with accuracy.

Sober reflection is causing hesitation among those who thought a saviour had been found.

The whole of this enormous investment might perhaps earn 6·7 per cent. interest if traffic remains normal. But there is no certainty that railways will regain traffic which has been lost to the roads, or even that road transport will not cut still further into railway receipts, or that our lost export trade will be regained. A time of falling traffic is not one in which schemes should be embarked upon which are suitable for dense and increasing traffic. Electrification at this time is like a gamble on the margin when values are falling. If the estimated volume of traffic should not materialise, the return on the investment would be nil, and then all that the country would have to show for its millions would be a series of over-powered generating stations and unwanted electrical equipment.

It is anticipated that the scheme would take twenty years to complete, and that the full benefit will not be derived until it is completed. Meantime, who is to say what revolution in methods of transport or current distribution may have occurred? A wholesale scheme such as this is particularly liable to attack from obsolescence. Brains are no less active now than in the past twenty-five years, which have seen the growth of motor transport.

Admittedly, the expenditure of this vast sum will give employment; but rather than take a bad gambling chance let the money be spent on such things as land reclamation, landing grounds, harbour improvements, afforestation, or in building and endowing schools, hospitals, and so on, so that the country would have something useful to show for its money.

Electrification itself will not produce traffic which could not be obtained by other and less sweeping methods.

Roads have been able to pull traffic from the railways for reasons of novelty, cheapness, expedition, delivery to the door, scenic attractions, and human interest, and in some cases through frequency of service. Of these, the novelty element would appear to be exhausted, yet the motor coaches carry on an increasing business, in spite of inability to take luggage and of greater risk to the passenger. Road transport will be still further favoured when the heavy oil engine is introduced.

In regard to cheapness. It would be interesting to know to what extent rates by road coach would be increased if operators were charged their share of the capital cost of the roads, which is estimated at over £2,000,000,000, and of traffic control, lighting, and if statutory obligations were imposed, such as railways bear. It would be a national calamity of the first order if railways were to become bankrupt, and we look to the Minister of Transport to prevent expenditure on roads which is itself uneconomic and which would strengthen the attack on the arteries of commerce. The roads are not in a position to carry heavy goods traffic at railway rates.

Railwaymen have been slow to learn from the unhampered omnibus operator. Perhaps they have even despised him. The passenger goes to the railway station to get transported in comfort with his baggage, but not to sit in a motionless train in a corner seat, nor to watch the girls pushing refreshment wagons up and down the long platform, nor to finger the books on the stall. He has no interest in the length of the train so long as it provides him with a seat, nor in the weight of the locomotive.

Railwaymen have allowed the idea of long, heavy trains running at infrequent intervals to become an obsession, even a glory. Transport papers exhibit views of great locomotives and passenger trains as they thunder over specially constructed bridges. Yet the passenger does not wish to search "Bradshaw" to learn his connections. He would like to arrive at a station, step aboard a car, and to be transported at once, and to know that if he has to change he will have at worst five minutes to wait.

The seating of a road coach is more comfortable than the railway carriage, and the windows are more generous and are better arranged for observation. I think that most people prefer the familiarity of an open coach to the privacy of a compartment. But, by reason of smooth running—which permits reading—railways can give much greater comfort than any road coach, and can win back traffic if they adopt improvements.

The experience of road vehicle design must be utilised to reduce the dead load of vehicle per passenger. The amount of non-paying load to be moved up and down hill, to be accelerated and stopped, can be reduced to something like one-third of what it is now.

Road coaches have an advantage in the matter of delivery at the door. Yet even this pull may be met by the railways. An omnibus sets down and picks up on demand; a road coach runs a limited stop; a rail car must stop at any road crossing which can be made accessible and even at any spot at all on demand, and the passenger must look out for himself, as he has been taught to do on the road. It is strange that ribbon development has so rapidly followed the omnibuses, whilst in a long period there has been no tendency to ribbon along the railways. The persistence and conservatism of the heavy train idea, fostered by the seriousness with which personal injury was regarded—as compared with road accident now—has prevented this rise in land values, and has stopped the railways from taking full advantage of the opportunity they themselves had opened up. Omnibuses should distribute from railway stations and interchange should be facilitated. This will fit in with a five-minute service better than an hourly one.

Experience has proved that a frequent service invites and receives copious traffic. I look forward to operation at not more than two minutes' headroom—when traffic demands—with augmented or automatic signalling. With development and experience, it may even be found possible to dispense with most signals, and to run at sight like a motor car, with much reduced headroom. As an example of the trend of thought I mention the "Michelines" rail-bus, which can be brought to a stop from 50 m.p.h. in 115 yards.

I consider an intensive service of rail cars, conceived with freedom from convention—like the coach operators have done—and applied with a broad outlook, as a solution of a large part of the railway difficulties.

Partial electrification may follow when, if ever, the intensive service has reached its limit of development.

Keep the passengers moving.

C. TURVILLE GARDNER,
A.M. Inst. C.E., A.M.Inst.T.

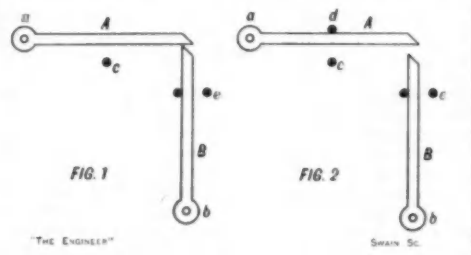
Ryde, September 13th.

A FRICTIONLESS UNLOCK.

SIR,—In connection with some experimental mechanical work upon which I have been engaged, it became necessary to use an "unlock" similar to that shown by Fig. 1.

In this arrangement A is a lever, pivoted at *a*, the end of which rests on the end of the lever B, pivoted at *b*, when the latter is in the position shown. When B is moved to the right, up to stop *e*, then A drops down on to stop *c*, as will be well understood.

Now, my aim was to make the friction between the



rubbing surfaces as little and as constant as possible: but, as is well known, with the best lubrication it is most difficult, if not impossible, to make this lubrication have a constant value, no matter how good the lubricant is, and I wanted it to have an absolutely constant value under all conditions. I at last effected the required object by a very simple device, which, I believe, is novel and by means of which friction is not simply reduced to a minimum, but is absolutely eliminated.

The arrangement is shown by Fig. 2. The two levers are the same as in Fig. 1, but are of tungsten magnet steel strongly magnetised, this magnetism being such that the ends of the levers have similar polarities. Under these conditions the magnetism at the end of lever B repels the magnetism at the end of lever A and presses A up against the stop *d* so that A no longer rests on the end of B, but is separated from it by a small gap. On moving B to the right—which it is quite free to do—up to the stop *e*, the end of lever A is no longer under the upward influence of the magnetic repulsion, and immediately drops, as in case Fig. 1.

The arrangement works perfectly and indeed is almost uncanny in its action. There are many cases, in certain kinds of horological work especially, where the device would, I believe, be of value; it certainly eliminates friction, as must be obvious. H. R. KEMPE.

September 14th.

TRACING PAPERS.

SIR,—The letter in a recent issue of your journal over the signature of Mr. Thos. H. Webster, A.M. Inst. C.E., is of great interest, and worthy of the attention of three interested parties, viz., the draughtsman who uses the materials, the tracing paper manufacturer and dealer who sells them, the paper maker who makes the base material.

A challenge is thrown down to the British paper maker to rise to the achievement of the German manufacturer, to pulp his paper fine enough to meet the desideratum of (1) transparency, (2) strength or durability.

There are one or two points that should be considered before the blame—if such is justified—is laid at the door of the paper mill. Tracing paper, being a transparent material, is used by draughtsmen to obtain a drawn copy or tracing of an original drawing or other matter, to save time in re-measuring, &c., and to provide an "original" from which photo-prints may be obtained. It is an intermediary between the original drawing and a photo-print, and with modern reproduction methods there is no necessity to have concern over what is simply a means to an end.

Some misunderstanding would appear to exist in the comment "that all 'pure' paper samples come from Germany or Belgium." It may be that since the war "prepared," or, as it is termed, "the greased variety," has not been so prominent in trade sample books as in cases emanating from Germany; it is a fact that for over sixty years Germany, France, and Belgium have made, and still make, this variety in large quantities.

There is no apparent difference between "foreign" base paper and British base paper prepared in this country or in comparison with what is prepared abroad. In addition, the variety is not confined to the "shiny" quality, which appears to raise the objection.

The class of paper which it would appear is in the mind of your correspondent is what in the trade is known as vegetable parchment, greaseproof, natural tracing paper, or whatever other name such may bear. This natural tracing paper has been adopted in some drawing-offices since the war, though smaller quantities were sold before that event. Mainly because of this new use to which material primarily intended for such purposes as packing provisions, jam covers, &c., has been put, the trade have endeavoured to provide a greater degree of transparency and surface than was before obtainable, and it is gratifying to find that the endeavour is meeting with approval. But it is not offered as a satisfactory material to be used for the purpose of storing valuable drawings or records. One reason of its popularity in present days would appear to be that it is possible to obtain 50 yards of this natural tracing paper for the price of, or less, than the price of 20 yards of "prepared," but even that consideration has not cut off the demand for the "prepared" tracing paper, which is still in use in Government offices and in many of the large engineering, shipbuilding and other works, while architects, surveyors, and draughtsmen in all spheres still employ it.

The durability of the so-called "pure" paper depends, as is the case with the "prepared" or "greased" variety, upon the use to which it is put before being stored away. In either case the material is used as an intermediary for photo-prints, and there is evidence that the "pure" or "natural" tracing paper becomes brittle and perishes, owing to the effect of heat from the arc lamp, though only subjected to its action during the time necessary to obtain exposure of the photo-paper.

If security is the essential, a British-made bank paper, though possibly not so transparent as a vegetable parchment, will outlive the latter, and it should not be outside the possibility of a British mill to provide a quality from stock. Apart from that, any member of the Drawing-office Material Manufacturers' and Dealers' Association should be able to offer a quality that will meet with the approval of your correspondent.

W. A. HALDEN.

September 14th.

SIXTY YEARS AGO.

IN the autumn of 1871, so we gather from our issue of September 22nd, of that year, rumours were rife concerning forthcoming amalgamations among British railway companies. In the case of the London and North-Western and the Lancashire and Yorkshire companies, rumour had passed into certainty, and an official announcement had been issued concerning the basis of the proposed fusion. It had been agreed that the dividend to be paid on the Lancashire and Yorkshire ordinary stock was to be 12s. 6d. per cent. per annum more than that on the London and North-Western ordinary stock. The North-Eastern Railway, it was understood, was contemplating an amalgamation with the Great Northern under the title of the Great North-Eastern. According to some, the Sheffield Company was about to unite with the Great Eastern, but, according to others, it was to be absorbed either by the Great Northern or the Midland. In Scotland, the North British Company was reported to have two wooers, the North-Eastern and the Midland. In turn, it was rumoured that the North British was about to absorb the Great North of Scotland, in spite of the fact that the Scottish North-Eastern Company's territory lay between the two systems. In general, the opinion was held that before long the entire railway system would resolve itself into four or five large companies. Several of the amalgamations mentioned took place fifty years later. . . . In a leading article we dealt with the "Nine Hours' Movement," an agitation begun among the engineers in Sunderland for a reduction of the working week from fifty-nine to fifty-four hours. The movement had spread to the Tyne area, and we expressed the view that it was the intention of those responsible for it to carry it into successive districts until all the country had come into line on the point. Far too much we maintained had been written in support of one side or the other of the dispute. We refused to support the masters or to condemn the men. We were not convinced that the nine hours' movement was wrong. At the most, we would say nothing more than that it was premature. The extra hour of leisure which the workmen would secure would not, we argued, be employed by them profitably. In the course of another generation, when the improvement in the education of the working classes effected by the newly instituted school boards would come into action, the position in that respect would be altered, but for the moment the workmen were insufficiently educated to make good use of an extra hour's liberty. We warned those responsible for the movement to be careful lest it resulted in the wholesale importation of foreign workers into this country to take the place of British workers who refused the employers' terms. That importation had already begun in the affected districts in the North, and, in the course of time, would assuredly spread.

Railway and Road Matters.

THE new Minister of Transport, answering a question on September 9th, intimated that a committee, representative of the local authorities and the users of highways, was to be appointed to consider the question of the uniformity of road signs.

As showing the general interest taken in railway history and the fascination created by early locomotives and other such exhibits, it is gratifying to have the announcement by the London and North-Eastern Railway that approximately fifty persons a day have visited the Railway Museum at York during recent months.

THE annual commemoration day run from London to Brighton for veteran cars will take place on Sunday, November 15th. The run is organised by the R.A.C. to commemorate the coming into force of the Locomotives on Highway Act, 1896, which absolved motorists from the need to be preceded by a man carrying a red flag. The entry will be limited to three or four-wheeled vehicles that were manufactured in 1904 or earlier.

IT was stated herein on July 3rd that the railways of the United States had sent in an application to the Interstate Commerce Commission for authority to increase their freight rates. Without suggesting that such an application is justified, we would record that the net operating revenue of the Class I.—or principal—railways for the first six months of the present year was 238¼ million dollars, as against 377 million dollars in January–June, 1930.

THE running signals on the Metropolitan Railway at the point at Bishop's-road where that system joins the Great Western are automatic, whilst those on the Hammersmith and City—G.W. and Metropolitan Joint—also are automatic. The intervening length, over the Great Western, had, however, manually operated signals. In order to secure uniformity, that section also has now been provided with automatic signals, which, incidentally, has allowed two signal-boxes to be dispensed with.

THE phrase "typically Irish" is often used to illustrate an amusing incident. That, though, cannot be said of the gratifying and satisfactory solution of the difficulties that arose over the contemplated discharge of 600 men from Inchicore Works. The trouble has been disposed of by a scheme which provides that 1800 men shall be classed into sections of 600, and that every man shall take four weeks' holiday at his own expense between now and November. This means that 600 men will go on leave for a fortnight, then return for a month, and then go on leave for a further fortnight.

THE paragraph in our Seven-day Journal of August 28th, as to the completion of the equipment by the Great Western of automatic train control between London and Plymouth, Swansea and Wolverhampton, may be supplemented by mention of the fact that, according to the statement issued in October last and repeated in this column of our issue of October 31st, 1930, there yet remain the lines between Oxford and Worcester, Wolverhampton and Newport (Mon.), Westbury and Salisbury and Castle Cary and Weymouth to be dealt with. When completed, control will be in operation on 2140 miles and on over 2300 locomotives.

WE reported on June 26th last that the railways of New Zealand were to be administered by a Railway Board. The Wellington correspondent of *The Times*, cabling under date of September 10th, states that the new Board has reported to Parliament, recommending that no further work should be done on six new railway lines, including the South Island main trunk line. Work on several other lines was suspended last year pending investigation. The Board holds that completion of the lines at a cost of £6,000,000 is not justified, as the lines would not pay interest on construction costs, or even, in some instances, on operating costs.

THE Ministry of Transport railway statistics for June, noted herein on September 11th, also gave the results for the first half of the present year. They show, compared with the corresponding period of 1930, a decrease of 5·4 per cent. in the number of journeys, of 8·1 per cent. in the receipts from passengers, and of 6·9 per cent. in all passenger traffic receipts. There was a reducton of 14·2 per cent. in the freight tonnage, and of 10·5 per cent. in the receipts therefrom. Merchandise fell by 13·9 per cent. in tonnage, and 11·1 per cent. in receipts, and coal, coke and patent fuel by 11·9 per cent. in tonnage and 5·9 per cent. in receipts. Passenger train miles were 1·1 per cent. down and freight train miles 7·5 per cent.

IT will be ninety years on the 21st instant since railway communication between London and Brighton was completed. The success of the Liverpool and Manchester led to different schemes coming before the sessions of 1835 and 1836, all of which were, for varying reasons, rejected. As the Parliament of 1837 was faced with another four schemes, it was agreed, on the advice of the Home Office, that Captain Robert Alderson, R.E., should report upon the plans and make a recommendation. He reported on June 27th, and on July 15th, 1937, what was known as the "direct" line was sanctioned. It began by a junction with the line between London and Croydon, at a point then called "The Jolly Sailor," which is now Norwood Junction, and, in addition to the line to Brighton, there was a branch to Shoreham. The latter was built because of the harbour at Shoreham, in order that the people of Brighton could obtain coal at a lower rate than was then possible. The Brighton-Shoreham branch was opened first—on May 10th, 1840—then from the junction at Norwood to Haywards Heath on July 12th, 1841, and completed throughout on September 21st, 1841. John Francis, in his "History of the English Railways," observed: "The most direct, but the most difficult, way was chosen. The earthworks were of an extraordinary character, the bridges and viaducts were difficult and numerous, the tunnels were long and expensive. With such a combination who can wonder that, though the first report of the directors stated that the whole cost would not exceed £23,376 per mile, the actual expenditure amounted to £37,569 per mile, an increase of £14,193 per mile.

Notes and Memoranda.

THE Union Minière du Haut Katanga has devised a system of building bungalows throughout in copper. It is said that they can be built in 24 hours and inhabited in eight days.

THERE are, it is said, 2,006,040 Post Office telephones in Great Britain and Ireland. One call per line per day represents an annual revenue to the National Exchequer of £3,050,852 10s.

IT is claimed that the Karighata tunnel on the Irwin Canal in Mysore, which has just been completed, is the largest irrigation tunnel in India. It is 9183ft. long and oval in section, 15ft. by 12ft. It has a discharge capacity of 2150 cusecs and was started in 1927.

THE iron and steel works plant being erected at Dagenham for the Ford Motor Company, Ltd., when completed, will consist of one blast-furnace, forty-five coke ovens, and an ironfoundry. It is not intended to install steel-making plant, rolling mills or a steel foundry.

A STENCH-GAS injector has, according to the *Canadian Mining and Metallurgical Bulletin*, been installed at the collar of No. 3 shaft on the main compressed-air line entering the Frood mine, Ontario. It contains two 1000 cubic centimetre flasks of ethyl mercaptan, which can be separately injected into the air line as a fire warning to men underground. In a recent test, using one flask only, the stench penetrated all parts of the mine in 10 minutes.

THE South Rhodesian Government has recently installed a fully equipped metallurgical laboratory, where practical tests can be made on all types of gold ores, free of cost, by the Government Metallurgist. The plant consists of 75-lb. stamp dolly and amalgamating plate, blanket table, concentrating table—curvilinear type—small tube mill, air compressor and agitators and vacuum filter plant. The whole of the plant is electrically driven. A mineral separation experimental outfit is also to be added for more refractory and complex ores.

IT is officially intimated that the experimental Drumm battery train will be ready for running on the Dublin-Greystones railway line towards the end of September. Each of the coaches—which are being built at the Inchicore works—will seat sixty passengers; two coaches will be the first instalment, and two more will be built after the completion of the first. The battery tests, it is stated, have been satisfactory, both as to endurance, speed and "life." The two charging stations, one at Amiens-street and the other at Bray-street, Dublin, are well advanced.

UNDER an appropriation of 900,000 dollars by the United States Congress for the Forest Products Laboratory, contracts have been let for a new building and plant at Madison, Wis. The main structure, 275ft. long and six storeys high, with 175,000 square feet of floor space, will, says the *Engineering News-Record*, include a pulp and paper research department, dry kilns, cold rooms for keeping logs and timber in uniform condition, a woodworking shop and facilities for experimental work in wood chemistry, timber preservation and other activities. Testing machines of 1,000,000 lb. capacity will be served by cranes on a gallery which will accommodate pieces 100ft. long and 30ft. high. There will be a 630 H.P. power plant.

THE twelve major topics announced for discussion at the third International Conference on Bituminous Coal to be held under the auspices of the Carnegie Institute of Technology, Pittsburgh, on November 16th to 21st, are as follows:—Cleaning and preparation; hydrogenation; by-products; fertilisers; low and high-temperature carbonisation; gasification; combustion; railway and steamship fuel; smoke abatement, dust removal, and flue gas purification; origin, classification and properties; competition between coal and other fuels; storage of coal. The following countries are among those to be represented:—United States, Austria, Great Britain, Czechoslovakia, France, Germany, the Netherlands, Poland, U.S.S.R., Spain and Switzerland.

ACCORDING to particulars given in a recent issue of the *Bulletin d'Information et de Propagande*, of Paris, important developments in electrically operated refrigerators are taking place in France. In Paris there are in operation about 4500 domestic cabinets, 2000 commercial refrigerators, 200–300 commercial installations of considerable capacity and 35 central refrigerators for blocks of flats; some of these are connected with building blocks having about 30 cabinets in flats connected to a central compressor. The supply of ice-cream to the public has led the Gervais Dairies to put in 300 electric refrigerators. A number of hotels and restaurants have central plant with a series of cold safes to suit the requirements of different food products. The firm of furriers "Revillon" has installed electrically driven refrigerating plants at two of their establishments. In the suburbs of Paris there are 540 domestic safes and 120 commercial installations. In the provinces the commercial applications seem to be going ahead faster than those for domestic service. In North Africa there are 700 domestic appliances and 350 of an industrial character.

A NEW type of cell for the electrolytic purification of water, was recently described by Professor Jean Billiter to the American Electrochemical Society, and, says the *Chemical Trade Journal*, seems to hold out hopes, if not of an immediate industrial future, at least of indicating the direction in which progress is most likely to be made. The results so far obtained indicate that both initial and operating costs compare favourably with distillation costs. An ever-present difficulty in plant of this type is that of preventing the diffusion of the ions back from the electrodes into the body of the water. In the ordinary electro-osmotic process, the ions diffuse into the water of the outer compartments. In a one-cell plant this method is not possible, but what Professor Billiter does is to employ two empty outer cells. The hydrostatic head in the centre cell thus sets up a water diffusion force through the electrodes, which opposes the diffusion of the ions back into the water. But this, in its turn, means a loss of between 10 and 40 per cent. of the amount of water treated. The balance of advantages and disadvantages will, undoubtedly, need careful consideration, but the technical possibilities are undoubtedly interesting.

Miscellanea.

THE mineral production of Canada for the first half of this year was valued at £19,000,000.

THE Italian Government proposes to expend £2,700,000 on new telephone construction and extensions.

THE Government of Alberta proposes to appoint a temporary commission to study forest conservation.

THE Packard Motor Car Company, of Detroit, has started a factory in Windsor, Ontario, for the manufacture of motor cars.

A LIGNITE carbonisation plant has been brought into operation on the Waikato coalfields, New Zealand. The process is a German invention.

THE Hull Chamber of Commerce is advocating the abandonment of the Humber Bridge scheme in view of the need for national economy.

IT is proposed to run the trams of Toronto on an underground track beneath Yonge-street, one of the principal thoroughfares of the city.

THE Chinese Ministry of Railways proposes to expend £750,000 on British materials. The purchases are to be made from the Boxer indemnity fund.

THE Power Corporation of Canada proposes to expend 8,000,000 dollars on prospecting for and the distribution of natural gas in Southern Saskatchewan.

IT is said that a deposit of lithium ore, containing 6 per cent. of the metal, has been discovered near Upington, in the North-West Cape Province of South Africa.

WORK has begun on the laying of a new submarine telegraph cable between Marseilles and Tunisia to supplement the existing cable. This cable was put into service in 1898.

A NUMBER of industrialists in Shanghai are planning the establishment of a new cotton mill with a capital of 1,000,000 dollars, of which a quarter is to be raised by the promoters themselves. The object of the mill is to turn out yarn of finer counts for the Chinese weaving and hosiery knitting mills so as to make them independent of imported yarn.

AN exhibition of modern optical instruments has been arranged at the Science Museum, South Kensington, and will remain on view until the end of October. Among the two hundred exhibits are apparatus for spectrophotometry in the ultra-violet, an aerial camera which takes 100 photographs with one filling, a projection microscope magnifying up to 5000 times, range finders, theodolites, &c.

IT is reported by the National Federation of Iron and Steel Manufacturers that the number of blast-furnaces in operation at the end of August was sixty-four, six furnaces having been blown out during the month. Production of pig iron amounted to 275,700 tons, compared with 317,000 tons in July and 416,700 tons in August, 1930. The production included 58,400 tons of hematite, 104,600 tons of basic, 89,900 tons of foundry, and 13,200 tons of forge pig iron. The August output of steel ingots and castings amounted to 357,300 tons, compared with 428,700 tons in July and 451,300 tons in August, 1930.

IT is claimed that a European tunnelling record has been put up in the construction of the Halkyn drainage tunnel, in North Wales, of the British (Non-Ferrous) Mining Corporation. This tunnel is about two miles long and measures 8ft. by 10ft. in section, with an additional 4ft. by 2ft. ditch for temporary drainage. In one week of 144 hours 20 minutes the tunnel was pushed forward, in hard limestone, a distance of 184ft. The rapid progress appears to have been largely due to the use of mechanical conveying appliances, by the Sullivan Machinery Company, for carrying away the spoil from the face. Since the occasion just mentioned, an even better performance has been put up by the men, and 217ft. of tunnelling was finished in twenty-one shifts totalling 168 hours. The net result is that 570ft. were done in 450 hours.

OWING to the measures of economy adopted by the Austrian Government, the electrical engineering industry has been disappointed over a good proportion of the business which it expected this year in connection with the electrification of the State Railways. The postponement of the construction of the power station at Persenberg has been another disappointment. In consequence of the deferment of these plans, and as a result of price cutting on the part of foreign competitors, the industry—particularly the high-voltage branch—is in a very depressed condition. Nearly all the works are adopting short time. There are prospects of some business with the South-Eastern States, notably Jugo-Slavia, where schemes for power stations are on foot, but they do not look very promising on account of the long terms of payment that are required.

A COMPREHENSIVE wood preserving exhibit, which the British Wood Preserving Association is arranging in connection with the forthcoming meetings of the Forestry Sub-section of the British Association from September 23rd to 30th, will be staged in the Department of Botany, Imperial College of Science, Prince Consort-road, South Kensington, and will remain open during the whole meeting. A large portion of the exhibit consists of fence posts of many species of home-grown timbers collected from estates in Great Britain, which illustrate very markedly the advantages of some form of preservative treatment if timber is required to give a good life in service. Side by side with posts of timber naturally non-durable which have been made to give a life of from twenty to twenty-five years through proper treatment are specimens of the same timbers, from the same sites, which show considerable decay in from two to six years through not having been treated. Other exhibits illustrate how timbers, such as Douglas fir, which do not take preservatives readily, even under pressure, can be made to absorb preservatives readily and evenly through being "incised" before treatment. A section of the exhibit is devoted to the attacks of fungi and insects upon timber used in buildings, both at home and abroad, and copies of booklets, &c., dealing with remedial measures are shown. The ravages of marine borers in timber structures from home and tropical waters will also be shown.

OLYMPIA EXHIBITION—SOME OIL ENGINES

(*For description see page* 284)

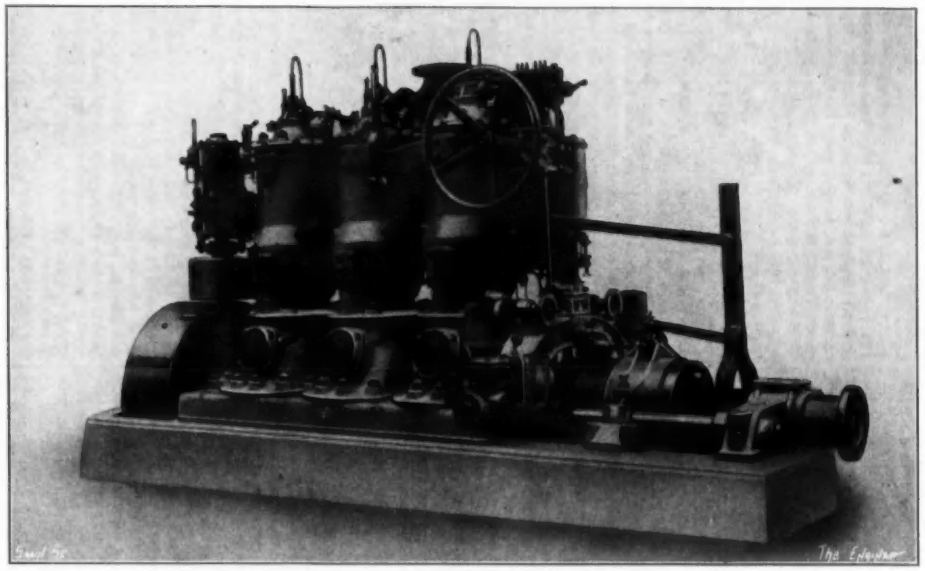


FIG. 54—150 B.H.P. COLD-STARTING MARINE OIL ENGINE—PERMAN

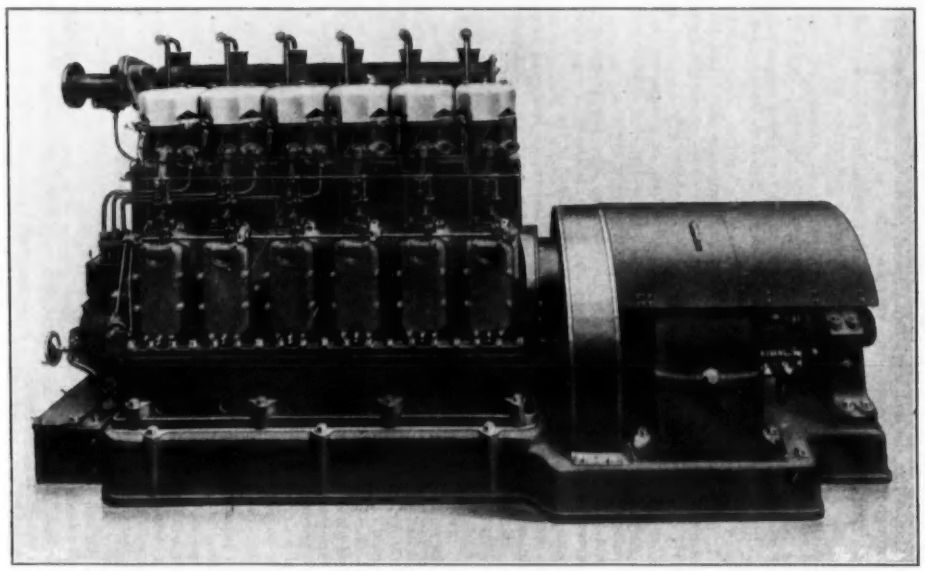


FIG. 55—150 B.H.P. AUXILIARY GENERATOR SET—NATIONAL GAS ENGINE CO.

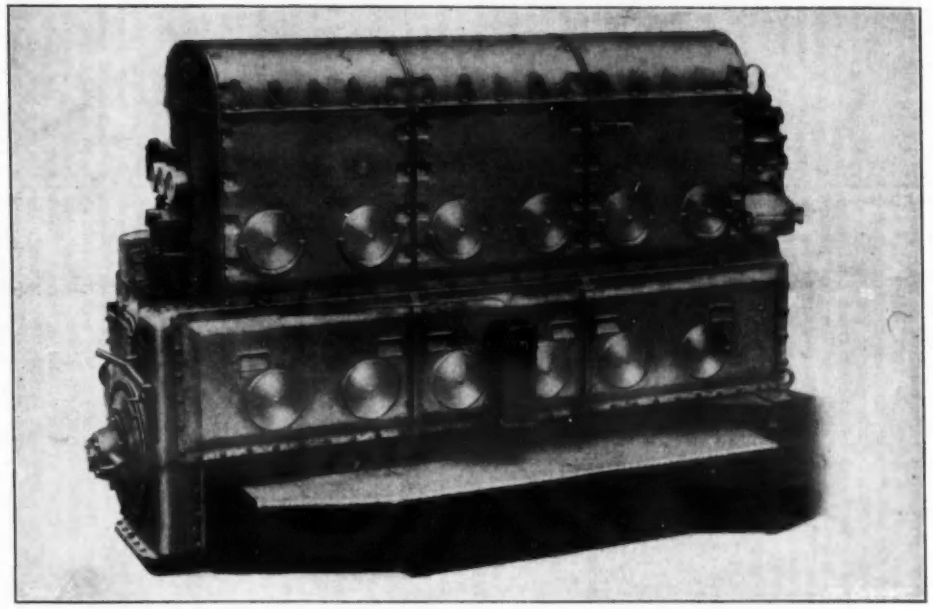


FIG. 56—250□B.H.P. LOCOMOTIVE TYPE OIL ENGINE—ARMSTRONG-WHITWORTH

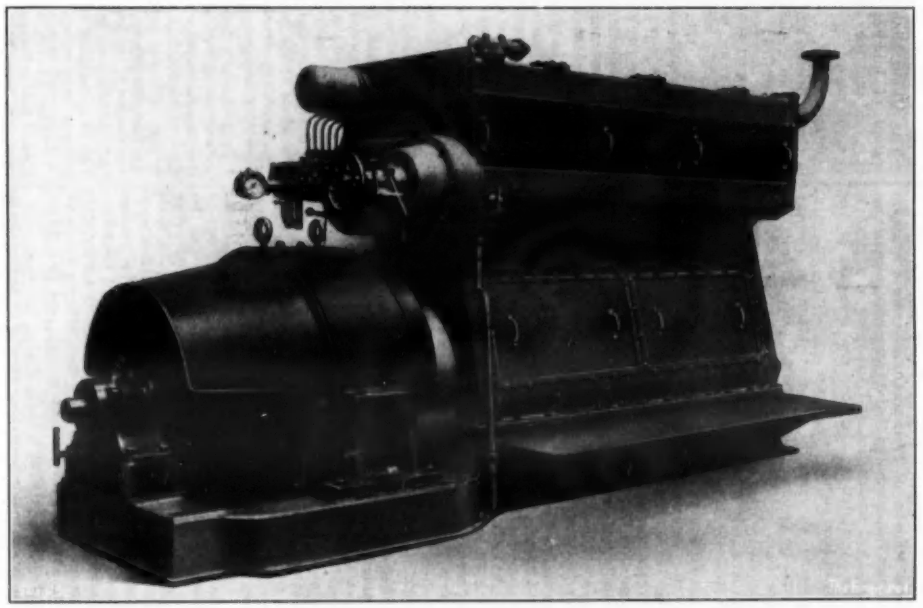


FIG. 57—300 B.H.P. STEEL FRAMED OIL ENGINE WITH GENERATOR—DAVEY, PAXMAN

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	Vittoria 18, and their Branches at Naples
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SEPTEMBER 18, 1931.

The Schneider Trophy Competition.

ON Sunday last, September 13th, Great Britain, for the third time in succession, won the Schneider seaplane trophy, and by so doing secured its permanent possession and brought the contest to an end. Flight-Lieutenant Boothman, flying a Supermarine Rolls-Royce S 6 B machine, covered the seven circuits of the triangular course—a total distance of 217½ land miles—at an average speed of 340 miles an hour. Immediately afterwards, Flight-Lieutenant Stainforth, on a similar machine, broke the world's record for speed on a straight course by flying four successive laps of 3 kiloms. each at an average speed of 379 miles an hour. In neither case did the pilot, the machine, or the engine suffer distress or mishap. To the achievement of these performances many people contributed in money, skill, knowledge, and daring. To them all the nation is indebted. At no time in our history could a success such as that of last Sunday have come more helpfully. The eyes of the world are at present upon our financial and industrial position, and upon the efforts we are making to conquer our difficulties. The third Schneider Trophy victory will be a tonic to our own people. To the foreigner it will demonstrate our determination to win through, and be a convincing proof of the fact that our technical skill has not decayed along with our trade balance.

The Schneider Trophy competition was established in 1912 by Monsieur Jacques Schneider, a member of the well-known Creusot family. It has been the object of contest, or of intended contest, on twelve occasions. This country has won it five times, Italy three times, the United States twice, and France once. On one occasion, in 1919, the contest was declared void. Twice before last Sunday a nation—Italy in both instances—has won the Trophy by flying over the course in the absence of competitors, and in five of the other contests the competition has been between only two nations. On two occasions the machines of three nations have met in contest, and only once, in 1914, have more than three nations competed for the Trophy. Until 1923 the competition attracted exclusively private or commercial entries. In that year the United States entered three naval machines for it, and found little difficulty in securing the Trophy. An official American service team was again successful in 1925. In 1926 Italy followed the American example by entering service machines and pilots. By that action the Trophy was brought back to Europe, and, as events were to prove, was prevented from finding a permanent home in the United States. In 1927 Great Britain for the first time entered service machines and pilots, and secured the Trophy. That success was repeated in 1929, and now for the third time in succession—although on this occasion only with the liberal assistance of private finance—a British service team has won. From the outset the rules of the competition have been framed to prevent the success of "freak" machines—machines, that is to say, which would be capable of flying at a high speed, but which would not justify their description as seaplanes. The preliminary navigability and manœuvrability tests have not been uniform throughout all the contests, but in every instance they have been such as thoroughly to demonstrate the marine qualities of the machines. That the British machines, at least, completely fulfilled the intentions of the rules in this respect is amply proved by the fact that one of our 1927 machines took part in the competition two years later, and that our 1929 machines were used for practice by this year's team. Each contest has witnessed a remarkable increase in the speed of the winning machine. In 1913 the Trophy was won by a French seaplane at a speed of not more than 61½ miles an hour. In 1920 the winning speed was 107 miles an hour, a comparatively small increase considering the period of intensive development in aeronautics which had intervened. The American winners in 1923 took the speed to over 177 miles an hour, and in 1925 they raised this figure to 199. The Italians next year brought the speed to 246½ miles an hour, and in 1927 the British machine won with a speed of 281½. In 1929 we increased it to 328½, and last Sunday it was carried to 340 miles an hour. Our latest performance has been described by some foreign critics as "modest and mediocre"! The increase in speed is perhaps less than some may have expected, but it is to be observed that modifications made in the rules governing the preliminary trials rendered it necessary to provide this year's machines with a greater fuel capacity than previously. The horse-power of the engines has advanced with the speed. In 1913 the winning machine had an engine developing only 160 H.P. In 1929 the British winner had an engine of 2000 H.P., and this year the power developed was still greater.

Now that the Trophy has been won outright by this country, the question is naturally being asked whether a fresh competition of a similar nature should be instituted. The arguments advanced in the early part of this year in favour of British official participation in the 1931 contest, at a time when that participation was doubtful, are not wholly applicable to this new aspect of the subject. It seems certain that if a new competition were started, none of the leading aeronautical Powers would participate officially in it. In its later years the Schneider Trophy contest became, all but in name, a competition between the nations' air forces. It is one thing to preserve the national prestige in a competition which had, by the action of others, been given such a character. It is quite another thing to perpetuate deliberately the characteristic at a time when the opportunity arises for doing away with it. The Schneider Trophy competition, we are convinced, has been beneficial to aeronautical research and to the aeronautical industry, and to many other branches of activity connected only indirectly or remotely with aeronautics. It is difficult to see in what respects these benefits would have been lessened if every country had uniformly refrained from official participation in the contest, and if it had been left entirely to private enterprise. On the whole, the element of military rivalry which crept into the competition in its later years may be regarded as objectionable. If a new contest is instituted, it would seem to be very desirable that it should be expressly confined to private machines and private pilots. Difficulties undoubtedly exist in the way of devising a competition on these lines. It will be difficult to frame the regulations in such a way as effectively to preclude the possible entry, unofficially, of Government machines and pilots. It will be difficult to find from private enterprise the necessarily large sum of money requisite for participation in the contest. It will be difficult to obtain the exceptionally endowed pilots for the machines outside the ranks of those in Government service. If these and other difficulties cannot satis-

factorily be overcome, it would be better not to institute a fresh competition, than to start one which could at the best be but a pale reflection of that which has now come to a close.

Railway Accidents.

In his annual report on railway accidents, Colonel Mount records that only one death in a train accident occurred to a passenger among the 1685 million journeys made in 1930. It is regrettable that a record so wonderful should be vitiated by the events since the present year opened. By January 16th there had been three fatal accidents, in which three passengers, three servants, and two servants respectively lost their lives; on March 22nd three passengers were killed at Leighton Buzzard and one more at Fakenham on May 27th. We have often pointed out, when considering this question, that the true test as to the safety of railway operation is the number of accidents and not the results thereof; a collision which has few personal injuries is as much to be avoided as one in which there is a loss of life. The present report shows that there were 242 collisions of every kind—passenger and passenger, passenger and freight, freight and freight, &c.—during 1930. That figure was lower than the average for the preceding ten years, whilst the 174 derailments of every kind were considerably less than the average. Moreover, the Ministry of Transport considered it necessary for the inspecting officers to inquire into only thirteen train accidents in 1930. That is the lowest such figure on record, the war years excepted, since the Act of 1871 sanctioned accident inquiries. The average for the first decade of the present century was thirty-three each year, and for the decade 1920 to 1929 twenty-two a year; hence the descent to only thirteen marks a great improvement.

With such an excellent record the time is approaching when legislation might be passed to render unnecessary these costly accident inquiries and their consequent reports, and, at the same time, the inspection of new and altered railways. Such inquiries and inspections began ninety years ago, in the earliest days of railways, and their scope was enlarged thirty years later—in 1871. Things were done then that are not done now, and the policy of the railways in respect of safety has entirely changed. Benefits from the official inquiries and examinations accrued in those days which are of no value now. The accident reports, when published, made the companies concerned take action, and they warned other concerns to put their houses in order. It was also a satisfaction to an engineer to have his work approved, and many a time, too, it was a perfect answer to a complaint if the railway affected could answer that a section had been "passed by the Board of Trade." We do not suggest that any change should be made in the reporting of accidents, nor in the annual returns, nor in the Chief Inspecting Officer's annual report. These are not only necessary, but serve a useful purpose for the railways themselves. The comparisons possible between the companies must be, not only encouraging for some, but stir others up to improve their own record. They also assist by showing the changes made, under the different headings, from year to year. It must, for instance, be a satisfaction to signal engineers and operating officers to see the number of collisions and derailments gradually being reduced; for mechanical engineers to know that last year only 6789 failures of equipment were reported, when the average for the five years 1920–1924 was 10,875, and for the civil engineers to see that the total number of broken rails was, for the same periods, brought down from an average of 209 to 127.

Automatic train control is mentioned in the report; not as associated with any particular accident, but as recording what is being done on the Great Western Railway and the trials with another, non-contact, system on the Southern. It is significant that of the accidents inquired into only two were due to the failure of enginemen to obey or observe "danger" signals. One of those undoubtedly would be that at Culgaith on March 6th—the only fatal train accident—which there is no question would have been prevented by automatic train control. The other presumably was that at Doncaster on December 26th, where the utility of control, owing to the short distance between the signal and the point of danger, was doubtful. We may therefore confidently offer the suggestion that if Sir John Pringle, in his reports for 1925, 1926 and 1927, when there were two, three and five collisions respectively which might have been avoided by control, said that justification for calling upon railway companies to incur the expenditure of automatic train control was still lacking, the same remark could, with greater force, apply to the accidents of last year. In making that comment we are encouraged by Colonel Mount's reference to the indirect means for securing greater security, which were alternatively recommended by the A.T.C. Committee in its report last November, such as the extension of the use of powerful colour-light signals. Schemes embodying this valuable feature have, Colonel Mount says, been approved for assistance under the Development (Loan Guarantees and Grants) Act, 1929.

Trade and Barter.

The extent to which the system of exchanging manufactured goods for produce is being developed in Germany should not be overlooked at a time when our prosperity depends upon a recovery of foreign trade. As customers in agricultural countries have not the money to buy manufactured goods, because they cannot sell their produce, German makers have long regarded the barter system as offering them the only means of trading in those markets. With the aid of the Government, which centralises the imported produce for sale, they have entered into an arrangement with Rumania on these lines. They have sent machines to Brazil and received coffee in exchange; copper wire and cables have been supplied to British India, and paid for in jute; and a contract has been entered into with an oil-refining company in Venezuela for machinery payable in oil and petrol. Similar business has been done with Italy, Mexico, and even with South Africa. A beginning has been made in Canada where coal and anthracite have been exchanged for wheat, and as Germany imports from Canada seven times as much as she sends to the Dominion, German manufacturers hope to extend considerably the exchanges by supplying machinery for metals and other manufactures against agricultural produce. The method of barter has extended to Scandinavia, and also to Italy, where an order has been secured from Russia for railway rolling stock to be paid for partly in oil. This return to a primitive method of barter appears to be unavoidable, so long as there is no relief in the economic situation, and if it enables Germany to secure business in countries which are only impoverished because they cannot sell their produce, it is probable that German manufacturers will maintain their advantage on a return to normal conditions.

Link in the History of the Locomotive.

GEORGE STEPHENSON'S FIRST EXPERIMENT.

By R. N. APPLEBY MILLER, F.L.A.

There is in the colliery office of Mr. W. Cochran-Carr, colliery owner, of Lower Condercum, Newcastle-upon-Tyne, an extremely interesting map or plan of the Great Newcastle coalfield. It is an original projection of the early nineteenth century, executed by a skilled draughtsman, and it shows the situation of all the pit shafts, wagonways, water-courses, staiths, &c., then existing. The chief interest to engineers, however, lies not in the location of coal pits, whose very names have long been forgotten, but in a delightful sketch at the head of the map—see Fig. 2—of a locomotive and its coal wagons passing in front of a tree-embowered colliery.

The engine—enlarged in Fig. 3—was delineated by someone skilled in the use of the compass and drawing pen. The "blotting-in" of the trees, colliery chimney, ventilating shaft cowl, locomotive and wagons with colour, may, too, be the work of the same hand; but it is certain that the work is good, and patently by one sympathetically inclined towards a decorative treatment of his subject. It was the combination of these qualities—technical accuracy with freedom of decorative treatment—which first attracted the attention of the writer. Examination showed further that the sketch or drawing is probably unique for its period, as representing one of George Stephenson's early experiments in steam locomotion, when he utilised the driving arrangement of the Murray-Blenkinsop locomotive for an adhesion engine. His first method of doing this is described and illustrated by Nicholas Wood in the first edition of his "Treatise on Rail Roads" (1825), and it will be noticed that the cylinders were placed near together at the centre of the engine as on the Murray-Blenkinsop locomotive.

"In the early part of 1814," says Wood, "an engine was constructed at Killingworth Colliery by Mr. George Stephenson, and on the 25th July, 1814, was tried upon that rail-road. This engine had two cylinders, each eight inches diameter, and two feet stroke; the boiler was circular, eight feet long, and thirty four inches diameter; the tube 20 inches diameter passing through the boiler. . . .

"Fig. III, plate IV [which is reproduced as Fig. 1] will show the manner by which the power of the engine was communicated to the wheels, and the loco-motion effected. A A are the wheels of the carriage supporting the engine; B B the frame of the carriage on which the boiler is fixed; *a b* and *c d* are the connecting rods, similar to *b c b c*, No. I, transferring the motion from the piston to the crank. *b c* and *d f* are the cranks which turn the two small cog-wheels *e f*; the cranks are placed in such a position with respect to each other that when one of them is perpendicular, or in a line with the connecting rod, the other is horizontal, and at right angles to it; and this arrangement is continually secured by the inter-position of another cog-wheel, of the same size, and working into the cog-wheels *e* and *f*.*

"Two larger cog-wheels, K and K, are fixed upon the axles of the carriage-wheels, which, when the small wheels *e* and *f* are turned round, by the rotatory motion of the crank, are also turned round, and with them the wheels of the engine. The wheels of the engine being thus turned round upon their axis, the friction of the rim of the wheels against the rails being regulated by the pressure upon them, and preventing the wheels from turning or sliding round upon the rail, would necessarily cause them to roll forward along the rail, and thus produce a progressive motion of the engine. . . . In this engine, the small cog-wheels *e g f* were each twelve inches diameter, and the cog-wheels upon the axles of the travelling wheels twenty-four inches diameter; so that the cranks made two

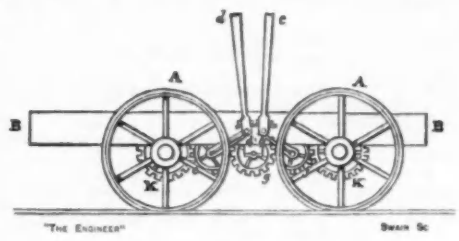


FIG. 1

revolutions for one revolution of the engine-wheels. . . . This engine was first tried upon the Killingworth Colliery Rail-road on July 27th, 1814, upon a piece of road with the edge-rail, ascending about one yard in four hundred and fifty, to draw after it, exclusive of its own weight, eight loaded carriages, weighing altogether about thirty tons, at the rate of four miles an hour; and, after that time, continued regularly at work."

Wood states that when the engine had been at work a short time it was found that sufficient adhesion existed between the locomotive wheels and the edged rail to give all the pull that was needed. Stephenson, however, had first tried an experiment which for all practical purposes made his engine a six-wheeled locomotive. "Grooved sheeves were fixed upon the hinder travelling-wheels of the engine and similar grooved sheeves upon the fore-wheels of the convoy-carriage containing coals and water, with an endless chain working over each, to procure the adhesion of the wheels of the convoy-carriage, in addition to the adhesion of the engine-wheels."

From Wood's description and illustration it appears that the engine itself was carried on four wheels, but that the experiment was made to obtain greater adhesion by coupling the two wheels of the tender to the four wheels of the engine, obtaining in effect a six-coupled locomotive. For purposes of adhesion this arrangement was found to be unnecessary, but it is nevertheless described in Stephenson and Dodd's patent specification of February, 1815, and shown on the accompanying drawing. The desirability of carrying the engine itself on six wheels in order to reduce the axle loads and the risks of breaking the cast iron rails then in use appears to have been soon realised, and Farey, the well-known writer on the steam engine, after describing the Murray-Blenkinsop locomotive, wrote in 1815, in an article "Steam Engines," published in Rees' "Cyclopædia" (1819): "A similar machine has been tried at Newcastle, but they have attempted to employ the wheels alone, without cogs upon the rails. To relieve the weight upon the rails, and obtain a greater re-action to advance the carriage, they applied six wheels for the carriage to run upon; and to make the bearing equal upon all six, the two middle wheels were applied to the piston of a small cylinder beneath the carriage, into which steam was admitted, and by its pressure bore up a portion of the weight of the engine; and accommodated itself to any inequalities of the railway." Now Farey's description, so far as it goes, is in general accordance with the sketch just brought to light, and the use of steam "springs" which were the subject of a patent by Stephenson and Losh in 1816 seems conclusively to show that the engine he was describing was by Stephenson.

Farey's has been the only evidence hitherto available to suggest that Stephenson may have built a second geared locomotive, but supported as it is by the evidence of the newly discovered sketch, we must consider this probability or its alternatives, if we assume that the sketch was made from "life."

* [It will be observed that the cut and description do not agree.—ED., THE E.]

Although Wood's account of the four-wheeled engine tried in July, 1814, was not published till eleven years later, it seems to be too circumstantial to allow reasonable doubts as to its correctness and to suppose that this first engine was on six wheels. If it had been so, the experimental coupling to the tender wheels would not have been necessary.

We are left, then, with two alternatives :—

Either, that a second geared engine was built, but on six wheels.

Or that the first geared engine was rebuilt on six wheels.

Against the first theory is the fact that before March, 1815, Stephenson and Dodds had produced the improved design which they then patented, with direct drive from the piston crossheads—or beams—on to the wheels and coupling by rods or chains. All gears had thus been eliminated, an important improvement to which Wood calls special attention. Stephenson would hardly have built another geared engine after March, 1815, and it seems equally unlikely that a second engine was built between July, 1814, and March, 1815.

We are left therefore with the second alternative, *i.e.*, that the first engine was rebuilt as a geared engine on six wheels in order to reduce the axle loads, and that this was the experimental engine described by Farey and shown by the newly discovered sketch.

The bed-plate, or engine frame, rather suggests timbers originally cut for a four-wheeled engine instead of for a six-wheeler. The builder seems to have got his extra length, without any unduly increased weight beyond the wheel-base, by placing the double timbers in echelon formation, *i.e.*, a short length of single timber projecting beyond the other, both fore and aft; the upper in one instance projects forward, and the lower, in the other, aft. This provided a platform in front for examining the pump and feed-water tank and a footplate behind, thus increasing the length of the locomotive considerably beyond that then usual.

Other considerable alterations would be required in the relative position of the cylinders, and to the gears, of which the intermediate wheels are considerably larger than shown by Wood for the first engine. The pattern of the driving and coupled wheels, too, is different, having curved instead of straight spokes, and these give some clue to the date and support the theory of a rebuild. The writer has examined a number of illustrations of coal wagons, all prior to 1816, and has not found any with wheels having curved spokes. During the year 1816, however, Messrs. Losh and Stephenson took out a patent for an improved travelling engine, rails, and wheels, among which is a pattern with curved spokes regarding which the patent specification reads: "Fig. 12 is a view of the cast iron wheel, with the malleable tire. This wheel is made with curved [wrought iron] spokes, as shown at *a a a a* [etc] in the drawing with a slit or aperture in the rim, shewn at *b* into which a key is inserted. The reason of this is, that on the application of the hot tire the cast metal expands unequally, and the rim is liable to be cracked, and the arms [spokes] drawn off, unless the first is previously slit or opened, and the latter curved, which allows them to accommodate themselves to the increased diameter of the wheel, by the formation of the wheel the tire might be forced on when cold and keyed up afterwards."

From this we may conclude that the curved spoke was invented and experimented with between February, 1815, when the patent drawing shows straight spokes, and 1816. It does not follow that such wheels were not in use before being patented.

Whether or not the locomotive now illustrated was Stephenson's second new engine or the first one rebuilt, it is certainly a remarkable link in the development of the locomotive on which little but fragmentary information has hitherto been given. The sketch, however, confirms such information on several important features of the design. It shows the exhaust steam taken direct into the chimney, an arrangement which Robert Stephenson, in his account of his father's invention, published by Smiles, states was "introduced not many weeks after the first travelling engine was placed on the Killingworth line." The sketch shows, too, a feed-water heater round the chimney, which Lecount, in his "Practical Treatise on Railways," states was used on Stephenson's first—or early—locomotive. Other features characteristic of George Stephenson's practice are the piston cross-head guides. These are of the type shown on an original drawing now at the Science Museum, believed to have been by Stephenson himself. (This drawing was first brought to light during the compilation of, but too late for publication in, Messrs. Robert Stephenson and Co.'s "Century of Locomotive Building," which, however, shows at the top of page 25 a similar engine.) For an illustration of, and article on this drawing, see the *Locomotive*, Vol. XXX., page 224. There is also a coloured reproduction in "The Railway Centenary," by Randall Davies (1925). Guides of the type shown, which were entirely different from those on the Murray-Blenkinsop engine, are still to be seen on the old Killingworth locomotive on the platform of Newcastle Central Station.

In consideration of all the evidence, there can be little doubt that the drawing now published for the first time represents an early Stephenson locomotive, though which one cannot perhaps be definitely stated.

For permission to publish the drawing, the writer and all who are interested in early locomotive history have to thank the owner, Mr. Cochran-Carr, in whose office it was the writer's good fortune to find it.

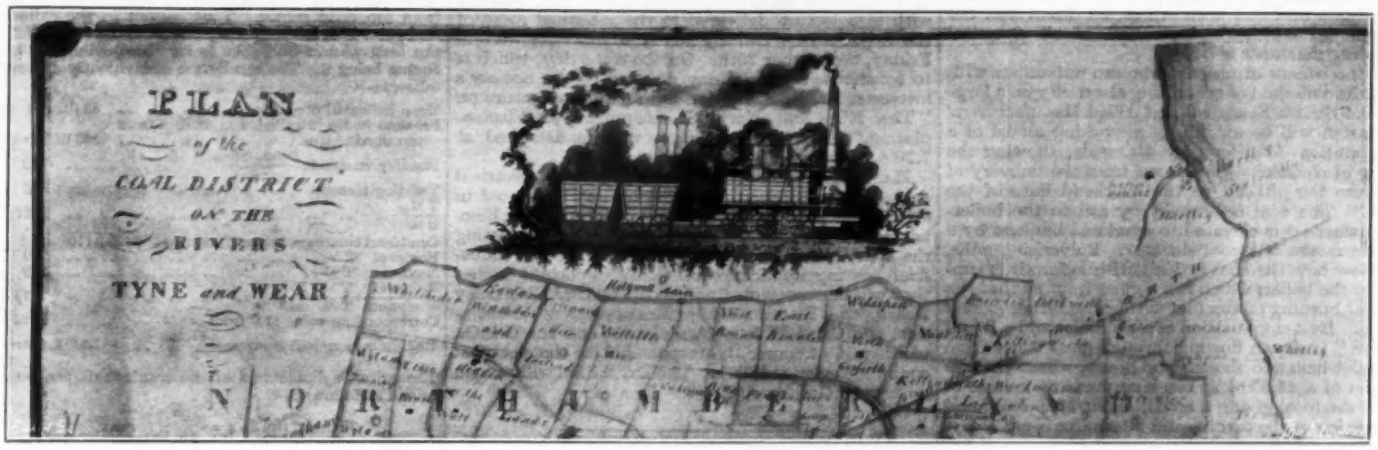


FIG. 2—PORTION OF A COLLIERY MAP, EARLY NINETEENTH CENTURY

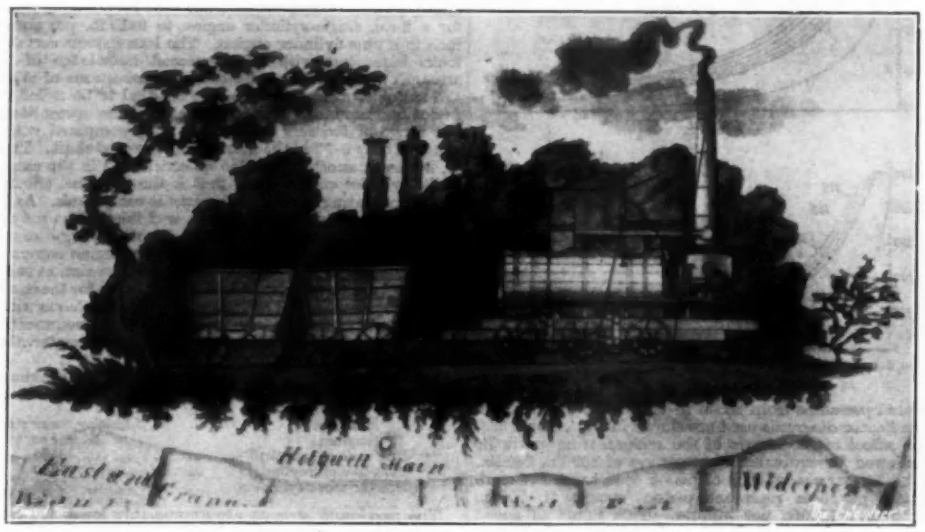


FIG. 3—ENLARGED VIEW OF LOCOMOTIVE

F.B.I. AND THE FINANCIAL SITUATION.

THE following statement was sent to the Prime Minister on Wednesday last by the Grand Council of the Federation of British Industries :—

The Grand Council of the Federation of British Industries has had before it the proposals of His Majesty's Government for dealing with the financial situation. It recognises that the balancing of the Budget has been the most immediate necessity, and loyally accepts the Government's proposals as emergency measures, and will support the Government to the utmost of its power in the task that it is so courageously undertaking.

The Federation, however, must point out that this heavy additional taxation will inevitably increase the burdens on industry, will raise the cost of manufacture and so further handicap our export trade. Still further economies, therefore, in both national and local expenditure are matters of the utmost urgency in order to correct the disparity between the standard of public expenditure in Great Britain as compared with that in foreign countries, which is so great a handicap to our competitive position in the markets of the world.

Important as balancing the Budget may be, the adverse balance in our foreign transactions is a fundamental cause of our present difficulties, and the Federation notes with satisfaction that this matter is receiving immediate and special consideration by His Majesty's Government. The Federation would point out that the financial instability in other countries, accompanied by the existence of large stocks of goods which cannot be absorbed in their normal markets, coupled with the pressing necessity for their realisation, greatly accentuates the danger of dumping into Great Britain, the only remaining open market with a sound currency. Dumping on a large scale in present circumstances may gravely imperil both our trade balance and the stability of the pound.

In the opinion of the Federation the remedy lies in the introduction of an immediate and adequate emergency tariff with the object of dealing with to-day's situation, and to prevent dumping; and thereafter in the establishment of a fiscal system which will combine the protection of our industrial and agricultural interests at home with the widest possible development of inter-Empire trade.

THE new power plant at the Globe and Phœnix gold mine, Southern Rhodesia, will, says the *S.A. Mining and Engineering Journal*, be completed in twelve to fifteen months, and will effect substantial economies in the cost of operation. It will include two direct-coupled gas engines and air compressors, each 1710 cubic feet per minute capacity and each with one high-pressure and two low-pressure cylinders. It is to be remarked that this is the first occasion on which compressors directly coupled *vis-à vis* to gas engines has been constructed, and the operation of the plant will therefore be watched with very considerable interest. In addition to the installation of this compressor plant, the hoisting equipment at the mine is being electrified. The maximum vertical depth attained in the mine at present is 3200ft. A subsidiary haulage which will enable mining operations to be eventually carried on down to a maximum vertical depth of 7000ft is being installed.

The Faraday Exhibition.

THE Faraday Exhibition, which opens at the Royal Albert Hall on Wednesday, September 23rd, will undoubtedly be a show of exceptional interest. Radiating from a central statue of Faraday, eight sections of the hall will be occupied by exhibits of things that have grown out of his experiments. Two of these sections will be devoted to chemical engineering; the others to the development of electric power, telegraphs and telephones, broadcasting, and to domestic uses of electricity. On the stands arranged by the Royal Institution most of the actual apparatus used by Faraday will be shown, including the magnet and coil with which he discovered the principle on which the operation of all electrical generating machines is based.

For the benefit of visitors who are unfamiliar with the modern method of generating electricity on a large scale the British Electrical and Allied Manufacturers' Association will be exhibiting a working model of a power station 45ft. long by 5ft. wide, showing the process of electricity generation from the delivery of coal from the pithead to the overhead lines of the "grid." The coal is brought by rail to the boiler-house, where it is elevated to overhead bunkers by a working model of a coal elevator. Pulverising mills, &c., show how the coal is dealt with before it is supplied to the boiler, which has a glass front so that the artificial burning of the fuel within the furnaces may be seen. By a combination of air bubbles and a liquid "steam" is shown flowing through glass tubes from the boiler-house to the turbine-house, where there is a model of a 25,000-kW machine made to a scale of ½in. to the foot, giving a model about 33in. long, and as a portion of the turbine and alternator is cut away, the rotating parts are shown in motion.

By means of glass tubes water is shown flowing from the river through the condenser. Between the turbine and boiler-houses there is an annexe containing feed pumps and heaters, &c., whilst on the remote side of the turbine-house there is the switchgear annexe. The control room is on the upper floor, the main switchgear in the basement, and the auxiliary switchgear on the intermediate floor. From the alternator to the switchgear and from the switchgear to the outdoor transforming station the connecting cables are represented by Neon tubes, whilst from the step-up transformer station overhead lines are shown passing to model steel pylons which are a copy of those actually used on the "grid." Printed notice cards call attention to the various working features of the model and are intermittently illuminated in sequence from the colliery side to the overhead line side of the model. From each of these notices spot lights are projected on to the particular part of the plant to which notice is called. In order that visitors may realise the magnitude of the transformers shown in the model two full-sized insulators are being placed at each corner of the stand.

On another "B.E.A.M.A." stand an attempt is to be made to illustrate the development of transformers and instruments from Faraday's discovery, but owing to limitations of space only the earliest types of transformers will be shown. Mr. Robert W. Paul, the organiser of the instrument section of the stand, has gathered together a collection of apparatus used in the early days of electricity up to the present time and has classified each type of instrument according to the fundamental principle on which it works instead of in accordance with its applications. All the instruments are concerned with the measurement by electrical means of mechanical forces; those concerned with the measurement of temperature, the acidity of liquids, and so forth having been excluded owing to limitations of space. The purpose of the exhibits is to illustrate the manner in which electrical instruments have developed from the discoveries of certain fundamental principles. While it will not be practicable to illustrate the work of every notable inventor, some impression will be given of the effect of new materials, such as the alloys of iron with nickel, cobalt, or silicon, of the effect on design of the use of plastic materials, such as Bakelite, and of the skill of the instrument mechanic. The B.E.A.M.A. will also be responsible for a display in the main entrance of a few examples of old generating machines, dating back to the years 1865–1890, whilst on a stand in the main hall there will be the first industrial generator used for electro-plating invented by Woolrich, of Birmingham, in 1844, and Sir Charles Parsons' first turbine, introduced in 1884. Still another important attraction will be a talking film produced by the British Thomson-Houston Company and presented to the I.E.E. Faraday Centenary Committee. In the film Sir William Bragg tells the story of Faraday. He deals with his humble origin, his work as a journeyman bookbinder, his appointment as a laboratory assistant at the Royal Institution at a salary of 25s. per week, and his subsequent work as an experimenter and philosopher. The film shows Sir William speaking at Faraday's lecture table and it presents the actual notebook which Faraday used at the first lecture he ever attended, delivered by Sir Humphrey Davy in 1812. Later in the film the crucial work of Faraday in 1831 is described, and he is shown working in his laboratory trying to find the connection between magnetism and electricity. When the experiment has been made the result Faraday is looking for is not found, because he does not realise that it is a transient effect. Subsequently, however, he is seen to observe the movement of the instrument needle as he breaks the connection and the problem is solved. Finally, Sir William Bragg pictures the consequences of Faraday's work, and the audience sees and hears electric tramcars and other electrically operated contrivances at work.

For some months past the Electroplaters' and Depositors' Technical Society has been actively engaged in the task of getting together exhibits relating to the applications of electro-deposition, and as a result visitors to the Exhibition who are interested in this class of work will be well catered for. The exhibits, we understand, will be representative of every phase of electro-deposition, which is to be dealt with in a lecture delivered in the rehearsal room of the Royal Albert Hall by Mr. D. J. Macnaughtan on Friday, September 25th. On the same day, which is to constitute a special day devoted to the Society's interests, Dr. R. S. Hutton is to deliver a lecture on "The Rise and Early Development of Electroplating." The former lecture will be delivered at 7.30 p.m. and the latter at 3.30 p.m.

Many other things that will appeal to electrical engineers, and indeed to all in any way interested in electrical science, will be on view. The British Electrical Development Association will be demonstrating the applications of electricity in the home and industrial heating applications. Other important bodies that will be represented will be the Central Electricity Board, the Electric Lamp Manufacturers' Association, the Cable Makers' Association, and the G.P.O., which will, of course, be responsible for the electrical communication exhibits. The Exhibition will remain open until October 3rd.

Crank Shafts for Double-Acting Diesel Engines.*

By S. F. DOREY, M.Sc., Wh. Ex.

(*Concluded from page 276.*)

SECTION III.—APPLICATION OF THE RESULTS OF SECTIONS I. AND II. TO DOUBLE-ACTING DIESEL ENGINES.

The procedure adopted for double-acting Diesel engines was similar to that for steam engines and single-acting Diesel engines. It was, however, considered that the variation of diameter of crank shaft with mean indicated pressure and speed should be investigated. Accordingly, results were obtained in the case of 2-s.c.d.a. engines for mean indicated pressures varying by 10 lb. from 65 lb. to 115 lb. per square inch, and for 4-s.c.d.a. engines for mean indicated pressures from 85 lb. to 115 lb. per square inch. The indicator diagrams used are shown in Figs. 4 and 5.

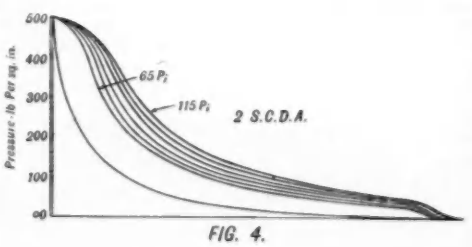


FIG. 4.

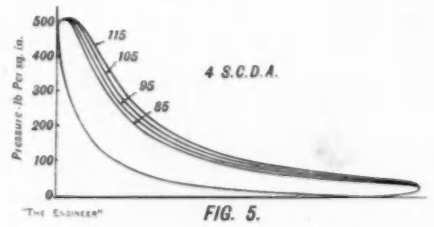


FIG. 5.

The effect of the inertia of the reciprocating parts I r was allowed for equivalent to pressures of 100 lb., 200 lb., and 300 lb. per square inch of piston area,† which, for all practical purposes represent piston speeds of 700ft., 1000ft., and 1200ft. per minute. This range of speed covers all speeds commonly adopted with large oil engines. The higher limit has been reached with 4-s.c.d.a. engines for passenger vessels, while in the case of 2-s.c.d.a. engines the limit reached is about 900ft. to 1000ft. per minute.

So far as mean indicated pressures are concerned, the tendency is to keep these moderate. Thus for 4-s.c.d.a. engines the M.I.P. is of the order of 90–100 lb. per square inch, compared with 130–140 lb. per square inch for 4-s.c.s.a. engines fitted with superchargers, whereas for 2-s.c.d.a. engines the M.I.P. varies from 80–90 lb. per square inch. With further experience and experimental investigation mean effective pressures may tend to increase.

To obtain the maximum permissible shear stress for any engine the method of procedure adopted may be illustrated by the following example.

Example.—Three-cylinder 2-s.c.d.a. engine. M.I.P. 85 lb. per square inch; piston speed 700ft. per minute.

The twisting moment for every 10 deg. of crank angle from the top dead centre was obtained for one cylinder in the usual manner by means of the pressures read off the indicator diagram for the respective piston positions, allowance being made for the inertia of the reciprocating parts and also the deadweight. For the bottom side of the piston an allowance of 12 per cent. in respect of the area of the piston-rod was made.

The total twisting moment for each crank was found by superimposing the twisting moments due to the previous cranks. By this means it was possible to find the crank at which maximum twisting occurred and also the range of T M at every crank. The position at which maximum combined bending and torsion (T_e max.) occurred was then determined by plotting the T M curve and the pressure in the cylinder over about 50 deg. in the vicinity of what was expected to give T_e max. In the case of the engine under notice T_e max. occurred at No. 2 crank at 32 deg. from top dead centre. The pressure in the cylinder at this point was 353 lb. per square inch, the value of Z from the last column of Table Ic for three-cylinder 2-s.c.d.a. engine being 8. The results are conveniently arranged as follows:—

Mean indicated pressure	85 lb. per sq. in.
Pressure in No. 2 cylinder at 32 deg. from top dead centre	353 lb. per sq. in.
Bending moment $\frac{\text{Press.} \times 2 \cdot 5}{8}$	110
Twisting moment	249
$\frac{\text{T M}}{\text{B M}}$	2·27
Combined twisting moment T_e max. $= \sqrt{249^2 + 110^2} =$	272
Range of T M	279
Maximum T M	249
Range of $\frac{\text{T M}}{\text{Maximum T M}}$ $\frac{279}{249}$	1·12
Corresponding value of C from Fig. 4	2·24
Maximum permissible stress $= \frac{11{,}200}{2 \cdot 24}$	5000 lb. per sq. in.

The suitable diameter d of the crank shaft can be determined as follows:—

$$T_e \text{ max. (in.-lb.)} = \frac{\pi d^3}{16} \times f_s \text{ max.}$$

If D is the diameter of the cylinder and S the length of stroke, both in inches,

$$T_e \text{ (in. lb.)} = \frac{\pi D^2}{4} \times \frac{S}{2} \times T_e \text{ max.}$$

$$d = \sqrt[3]{\frac{2\,T_e \text{ max.}}{f_s \text{ max.}}} \times D^2 S$$

$$\text{or } d = K \sqrt[3]{D^2 S}$$

$$\text{where } K = \sqrt[3]{\frac{2\,T \text{ max.}}{f_s \text{ max.}}}$$

In this example T_e max. = 272 and f_s max. = 5000.

$$d = 0 \cdot 478 \sqrt[3]{D^2 S.}$$

The foregoing example illustrates the method used for determining constants K for any type of double-acting Diesel engine so that sizes of crank shafts can be quickly obtained. The results of the investigation for 2-s.c.d.a. engines having one to nine cylinders and 4-s.c.d.a. engines having three, six, eight, and ten cylinders, with bottom cylinder firing immediately after top cylinder and for the various ranges of mean indicated pressure and piston speed are illustrated in figures and tables given in the paper.

By using the method proposed in this investigation the allowable shear stress varies from 4030 lb. per square inch for a 2-s.c. single-cylinder engine, to 8810 lb. per square inch in a nine-cylinder engine. The latter stress certainly looks high, but with our increased knowledge of the strength of materials under different conditions of stress, the factor of safety becomes less entitled to be called the factor of ignorance. Also, in the case of the lowest stress, the range of twisting moment is 1·36, compared with a range of only 0·32 in the most highly stressed shaft. There is, however, another point to be considered in the case of multi-cylinder engines, and that is the fly-wheel effect of the reciprocating and rotating parts at each crank. As the number of cranks increases the speed fluctuation may be reduced owing to the increased kinetic energy of the rotating parts of, say, an eight-cylinder engine compared with a three-cylinder engine. The torque variation at the aftermost crank will also be less in most cases for the engine with a large number of cylinders compared with one with a few cylinders, though the friction of the reciprocating parts of the double-acting engine will be greater than that for steam engines.

It is, however, thought that for the present the maximum working shear stresses should be limited as follows, viz.:—

2-s.c.d.a engines.	Limiting shear stress, lb. per sq. in.
One to four cylinders	6500
Five to eight cylinders	7000
Nine or more cylinders	7500

The maximum stresses are appreciably lower for 4-s.c. engines than 2-s.c. engines having the same number of cylinders.

In the case of eight and ten cylinders it is considered that with the heavy rotating masses the permissible stress might be increased. Accordingly, for eight-cylinder 4-s.c.d.a. engines it was decided to increase the value of the basic shear stress from 11,200 lb. to 12,500 lb. per square inch, the calculated working shear stress being increased proportionally; while for ten-cylinder engines a basic shear stress of 14,000 lb. per square inch is considered satisfactory. A further slight increase in the basic stress would be permissible, if, as in some cases, balance or counterweights are fitted to the crank webs of these large engines. This is dealt with in the next section.

It may be mentioned that with 2-s.c.d.a. engines having from one to four cylinders the ratio $\frac{T}{M}$ varies from about 1·6 to 3, whereas for five or more cylinders the ratio is generally above 4. Consequently, for engines with more than four cylinders the bending stresses are almost negligible. As mentioned previously, there are bending stresses that are likely to come on the shaft that are incalculable. There is also the condition of starting to be considered when the bending stresses may be most severe, though the duration of these stresses is comparatively

* North-East Coast Institution of Engineers and Shipbuilders, March 13th, 1931. Abstract.

† The vertical inertia force due to the reciprocating weights expressed in terms of pounds per square inch of piston area p at any instant is given by $-p\left(\text{Cos } \theta + \frac{\text{Cos } 2\theta}{4}\right)$ for length of connecting-rod equal to four times the crank radius.

short. It is for these purposes that the stresses in 2-s.c.d.a. engines have been limited to the figures given above.

It has been previously shown that the size of crank shaft for any particular engine can be determined from a formula of the type

$$d = K \sqrt[3]{D^3 S}.$$

The results of this investigation show that crank shafts for engines having a small number of cylinders are the most severely stressed when designed on a basis of a constant value of the working stress for all types of engines.

SECTION IV.—THE EFFECT OF THE MOMENT OF INERTIA OF THE REVOLVING MASSES AT THE CRANK SHAFT ON THE SIZE OF CRANK SHAFTS FOR LARGE 4.-S.C.D.A. DIESEL ENGINES.

Mention has already been made of the fly-wheel effect of the reciprocating and rotating masses at the crank shaft, and it is proposed to indicate briefly in this section the effect of these masses on the size of the crank shaft.

When the moment of inertia of the reciprocating and revolving masses at each crank is comparable with that of the propeller and fly-wheel, some irregularities of the twisting moment at each crank are absorbed by the angular acceleration of the crank masses, and consequently the maximum twisting moment found in the usual manner without allowance for the fly-wheel effect is somewhat reduced.

Let I_1 be the moment of inertia of one-half of the reciprocating mass plus the revolving mass at each crank of an eight-cylinder engine.

I_2 the moment of inertia of fly-wheel.

I_3 the moment of inertia of propeller.

T the mean twisting moment at, say, No. 5 crank after journal.

$T + \delta T$ the maximum twisting moment at after journal of No. 5 crank without allowance for fly-wheel effect.

Then, considering the system of engine, fly-wheel and propeller, with the assumption of uniform resistance at the propeller, the reduction in the value of the excess twisting moment δT is given by

$$\frac{5 I_1}{8 I_1 + I_2 + I_3} \delta T$$

and the amended maximum twisting moment becomes

$$T + \frac{5 I_1}{8 I_1 + I_2 + I_3} \delta T$$

It will be apparent that by a careful disposition of the rotating masses, such as fitting counterweights to the crank webs and reducing the moment of inertia of fly-wheel correspondingly, a slight reduction may be made in the diameter of a shaft.

If part of the $W k^2$ of fly-wheel was distributed as counterweights on the crank webs, a slightly smaller size than 19·4in. diameter would result. The paper concludes with a section on the shrinkage of webs on shafts and three appendices.

FIG. 3—OLD AND NEW DISTRIBUTION SYSTEMS

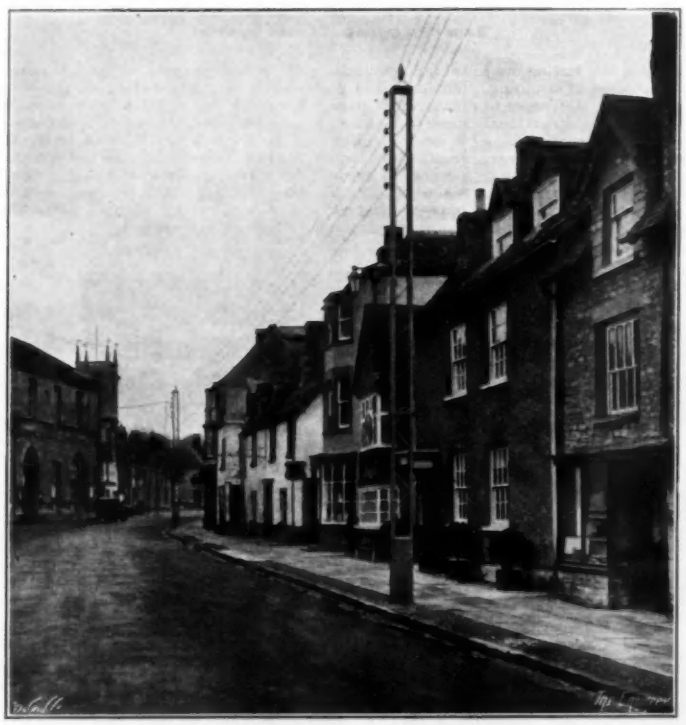


FIG. 1—DISTRIBUTION LINES IN A MAIN THOROUGHFARE

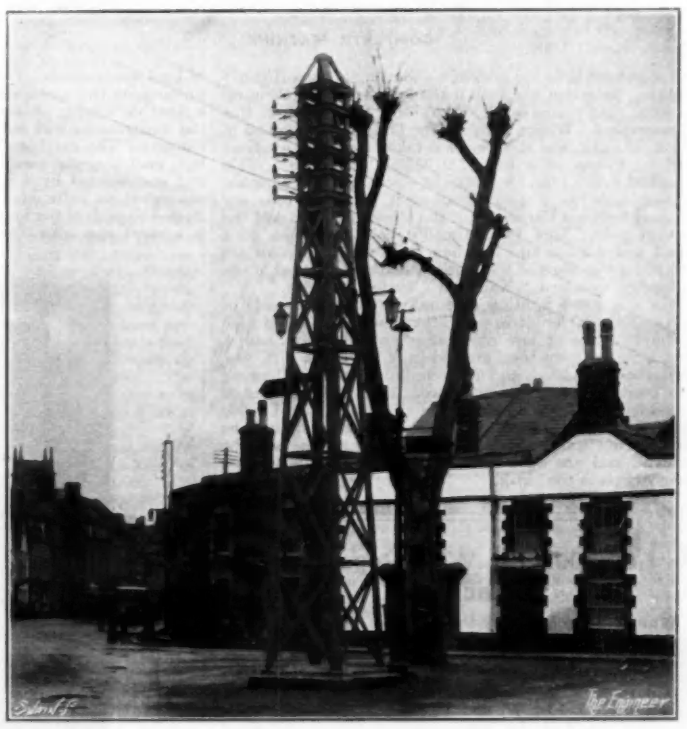


FIG. 2—LATTICE TOWER

Electrical Distribution at Woodstock.

ALTHOUGH it has long been realised that creosoted wood poles carrying overhead distribution lines are unsightly and ought to give place to something better in country towns and villages, up to the present no alternative form of structure has met with general approval. The ferro-concrete poles that are sometimes used on the Continent are not very adaptable to the varying conditions and irregular streets of English country towns, and when designed to meet the factors of safety required under British conditions they are apt to become heavy and fail to present a satisfactory appearance, although it is probable that some improvement could be made by a careful thought out ferro-concrete system. At Woodstock, where wood creosoted poles were originally in use, a marked improvement has been made by Callenders Cable and Construction Company by the introduction of the new "P.B." Callender pole manufactured by Painter Bros., of Hereford. The work has consisted of the erection of a complete low-tension main and street lighting scheme for the Woodstock and District Electrical Distribution Company, using lattice steel structures of pleasing appearance. Although it is perhaps premature for the contractors to claim that finality has been reached, the results, as the illustrations Figs. 1 and 3 show, are undoubtedly very encouraging. On the right of Fig. 3 one of the original wood poles, which have now been removed, is shown, whilst one of the new steel poles is to be seen immediately behind it. The illustration Fig. 1 shows a portion of the new system in one of the main thoroughfares. These illustrations convey a good idea of the improvement that has been brought about by the adoption of these new poles, and a general description of the whole scheme may prove of interest.

From the Wessex Power Company the town takes a three-phase 10,500-volt supply, which is brought in by an underground three-core cable connected to a kiosk situated as near as possible to the centre of gravity of the low-tension load.

The steel kiosk, which, like the cable, was made and installed by Callenders, is divided into seven chambers, one for low-tension apparatus, two for transformers, three for E.H.T. switchgear, and one for an instrument panel. Each transformer chamber is designed to take a 150-kVA three-phase, 50-cycle, 10,500/400 unit, although up to the present only one transformer has been installed. The three switchgear chambers contain, among other things, the incoming and outgoing E.H.T. cable, which loops in and out through a Callender standard E.H.T. triple-pole isolating and sealing unit before being connected to the main bus-bars, thus allowing the power transformer circuit and outgoing circuit to be interrupted at will. They also contain the two power circuits, each having a set of triple-pole isolating links on the bus-bar side of the triple-pole oil circuit breakers, which are rated at 200 ampères, 10,500 volts, and have a rupturing capacity of 50,000 kVA. At present only one of these circuit breakers has been installed.

The low-tension chamber is completely isolated from the remainder of the kiosk by partitions and is equipped with two pillar units capable of taking four-core P.I.L.S. and armoured cable up to 0·1 square inch. On the phases and links on the neutral these units have "Callender-Smith-Watson" fuses. A Venner "Autonoff" time switch for the street lighting, an ammeter, a voltmeter with a three-way and "off-section" switch, and a low-tension knife switch provided with flexible leads and plugs for removing fuses under load, complete the equipment of this chamber.

Metering is done by means of two semi-switchboard type, 20/5 ampère, 1100/110-volt, 50-cycle, three-wire kWh meters and two semi-switchboard pattern kVA maximum demand meters calibrated for a power factor range of 0·98 to 0·76 lagging. The overhead low-tension main is connected to the kiosk by a 400/230-volt paper insulated lead sheathed and armoured cable consisting of four conductors, each of 0·1 square inch section, and one conductor of 0·0225 square inch section. The pole mounting dividing box is of the tandem type and has been built into the top of the pole and forms an inconspicuous and neat arrangement.

For the distribution of the current light steel poles of the type illustrated and consisting of two vertical channels of special shape braced together diagonally throughout their length by ⅜in. circular rods, are used, the transverse—longitudinal strength ratio being 4–1 in accordance with the Electricity Commissioners' regulations. Owing to its lightness, the P.B. Callender pole is far less conspicuous than a wood pole of equivalent strength. In the direction of the line it is possible to see through the poles, whilst the side view merely presents a channel, 5in. wide, and when the poles are painted to conform with the surrounding stonework, their presence is scarcely noticeable.

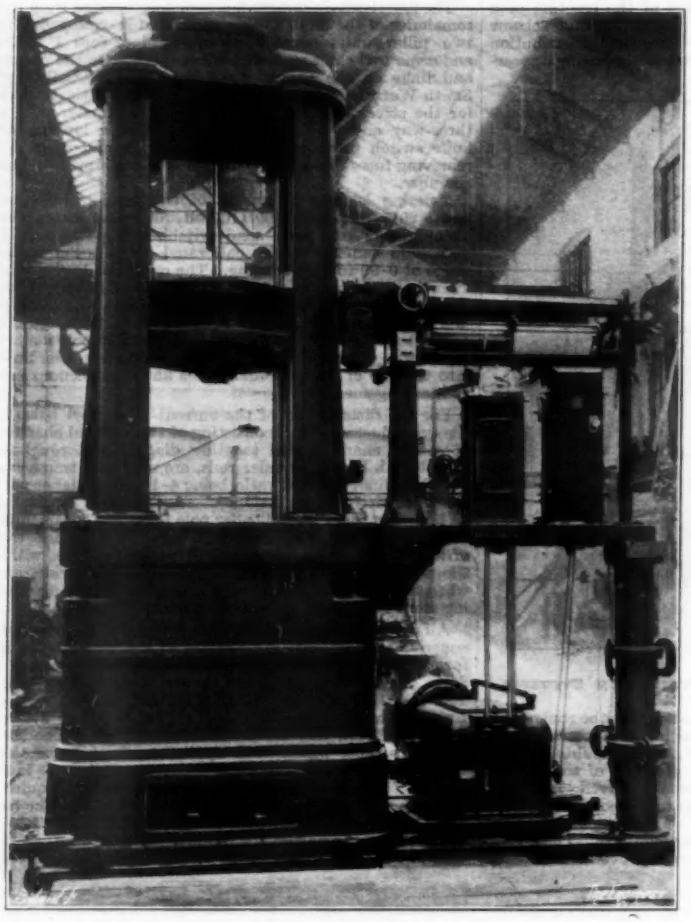
All the poles on the Woodstock system have been set in concrete foundations, and the transverse load in pounds for the 5in. poles used for the heights above the ground of 25ft., 30ft., 35ft., 40ft., 45ft., and 50ft. are 3488 lb., 2900 lb., 2492 lb., 2180 lb., 1964 lb., and 1744 lb. respectively. The corresponding longitudinal loads are 872 lb., 725 lb., 623 lb., 545 lb., 491 lbs., and 436 lb. The load given are those which when applied to the top will take the pole to its elastic limit and to determine the safe loads it is necessary to divide by the factor of safety required. The dimensions of the foundations in concrete for the 5in. poles used are—depth, 5ft.; diameter, 1ft. 9in.; whilst the depth of the pole in the foundation is 4ft. 6in. In the case of earth foundations, the diameter of the hole would be 2ft., and the depth of the pole in the ground 5ft., assuming a normal bearing pressure of 2 tons per square foot.

The conductors are supported by means of shackle insulators, which are attached to the pole by standard "D" irons and bolts, and to comply with official requirements where steel poles are used, a longitudinal earth wire has been run throughout the system at the top of the supports. This wire is efficiently bonded to each pole and connected to a galvanised earth plate at one point at least in every section. Below this earth wire there are the three 0·10 square inch stranded phase conductors, a No. 8 S.W.G. switch wire for the lighting system, and a 0·10 square inch stranded neutral conductor.

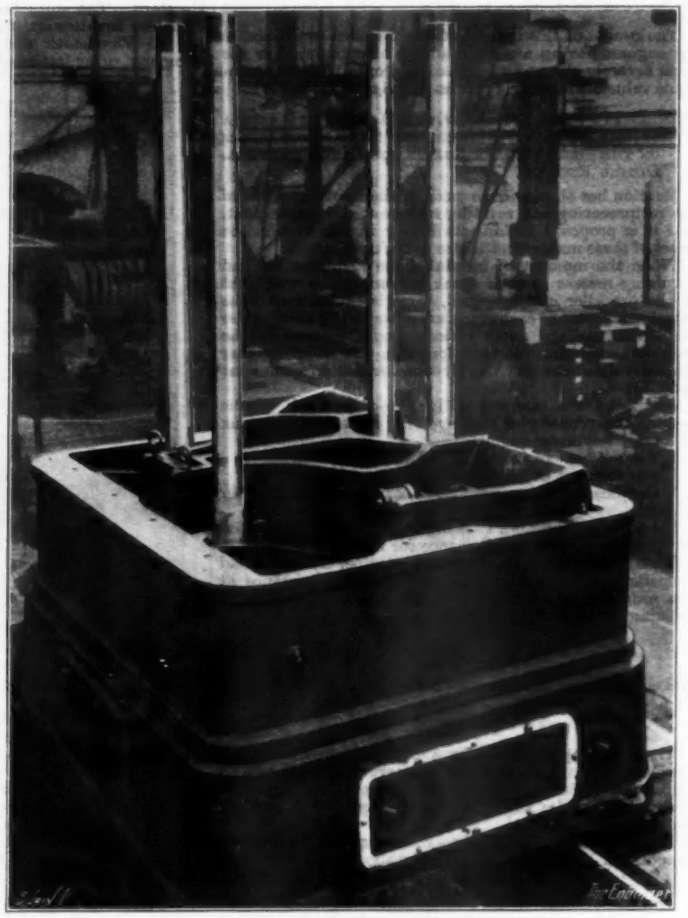
On account of the mechanical loads and the impossibility of erecting stay wires at certain positions, there are three points in the system where special self-supporting structures have been found necessary, and at them narrow base steel lattice towers, as shown in Fig. 2, have been erected. Each of these towers also forms an electrical sectioning point, and is provided with bus-bars to allow of the disconnection of any of the circuits. Although

TESTING MACHINE FOR 11-INCH WIRE ROPES

W. AND T. AVERY, LTD., BIRMINGHAM, ENGINEERS



COMPLETE MACHINE



BASE-BOX AND LEVER SYSTEM

at the present time the system is operating in three distinct sections, provision has been made for connecting them up to form ring mains as soon as the load justifies this arrangement. Where possible, the houses are supplied in blocks of eight, and the service is taken from the overhead line by means of a twin 7/0·064in. "Ancalite" cable attached every 18in. by means of electro-tinned phosphor bronze clips to a galvanised steel stranded catenary running between the centre of the block of houses and the nearest pole. This twin Ancalite cable is taken to a small distribution and fuse-box from which services are run along the front of the block of houses by means of the Callender standard "Kalibond" system.

For the street lighting scheme, use has been made of Revo octagonal lanterns, with brass frames and fitted with obscured glass of low absorption and 100-watt lamps. The lanterns have been erected at a height of 17ft. 6in. from the street level, and an even illumination of the road has been obtained without glare. Each lighting unit is protected by a double-pole fuse in a fuse-box placed inside the pole at a convenient height from the ground, and the lanterns are connected between the switch wire and the neutral, and are controlled by means of the automatic time switch in the kiosk.

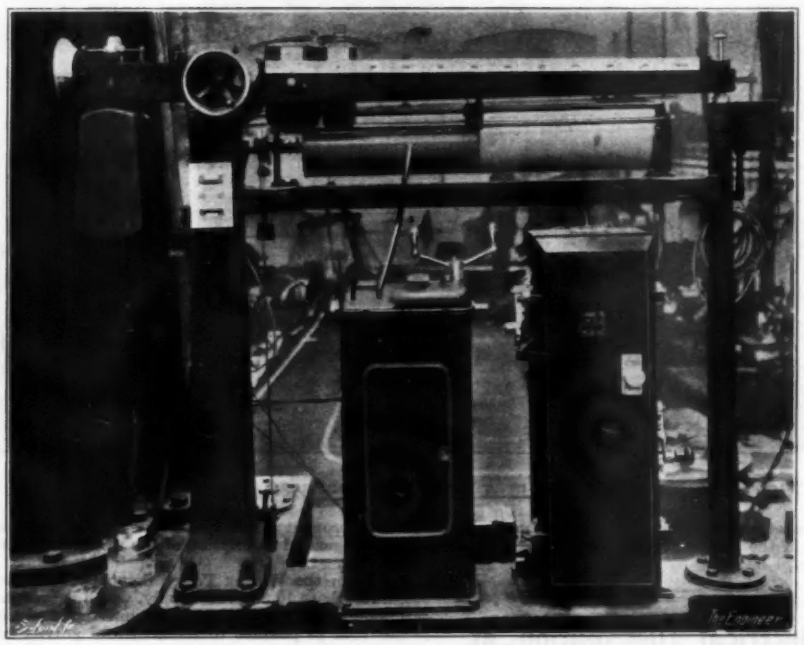
A 1,000,000 lb. Wire-Rope Testing Machine.

WHEREVER possible modern practice in the testing of materials is turning towards the testing of complete units of engineering construction on large capacity machines. An outstanding example of the equipment required for this purpose is the 1250 tons capacity testing machine, supplied in 1926 by W. and T. Avery, Ltd., to Dorman, Long and Co., Ltd., for testing scale models of sections of the Sydney Harbour Bridge.* Incidentally, it is interesting to note that the erection of the bridge has proceeded without a hitch, there being no failure whatever of any material or component. In the original James Watt workshop at Messrs. Avery's Soho Foundry, another high-capacity machine of a different type has just been completed, and whilst not so powerful as that constructed for Dorman, Long and Co., Ltd., it is of especial interest, in that it is the largest vertical compound lever machine yet made in Great Britain for testing wire cables.

This machine—illustrated in the accompanying engravings—has been made to the order of the Canadian Government Department of Mines, and is intended for carrying out tensile tests on wire rope specimens of 11in. circumference maximum, and 6ft. in length unstretched, to a capacity of 1,000,000 lb. We understand that a section of the new wing of the Government House, Toronto, is to be set aside for its installation, whither the machine will be transported by water, *viâ* Montreal.

In contrast with the machine supplied to Dorman, Long and Co., Ltd., a vertical arrangement has been considered more suitable, because, we understand, of the somewhat confined space allowed by the Canadian authorities, and the fact that tensile tests are well adapted to this form of load application. The design enables the testing staff to examine the specimen during the process of straining, a clear view being obtained from two sides. Reference to the illustrations will make clear the main constructional features. The machine has a massive three-section base box, enclosing the main lever system and straining gear, and surmounted by a heavily ribbed cast steel platform supported on knife edge bearings on the weighing levers. Bolted to each of the four corners of the weighing platform is a stout cast iron column. These columns support at their top ends the weighing crosshead, to which the upper end of the specimen is attached by means of a special form of split grips. Projecting through the weighing platform are four 5in. diameter steel straining screws for holding the cast steel straining crosshead, to which the lower end of the specimen is attached during the test. The lower ends of the straining screws are cut with a 1in. pitch square thread, and work in phosphor bronze straining nuts, which take the drive from a main worm shaft. Guide columns bolted to the base box support the straining crosshead in the course of its travel.

Preparation for a test involves the fraying of the ends of the specimen and casting in lead in conical-shaped moulds. The specimen is then lowered on to the recoil plate, the grips are placed in position—the specimen meanwhile being suspended—and the straining crosshead is lowered until the recoil plate can be attached. The recoil plate, when fracture takes place, serves the dual purpose of keeping the grips in position and taking up the reaction. The straining crosshead is then raised until the upper conical end of the specimen is in such a position that the upper grips can be lowered into place.



STEELYARD, CONTROL BOX AND RECORDING DRUM

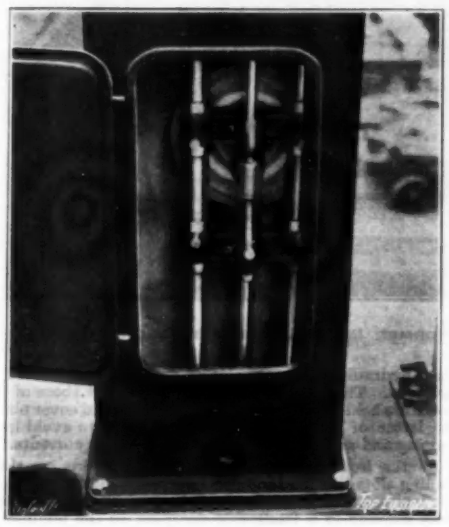
The specimen is now ready for testing. The load is applied by means of a protected reversible motor, driven off an electrical supply of 550 volts, three-phase, 25 cycles, and controlled by a combined stator and rotor drum starter. Coupled to the motor through a clutch operated from the control box is the gear-box, in which the speed is reduced by forged steel sliding gear wheels, mounted on ball bearing shafts and working in oil. The four worm wheels on the straining screws are all driven off a central worm shaft coupled to the gear-box. The thrusts are counteracted by the use of right and left-hand worms. Straining speeds of 0·1in. and 0·4in. per minute are

* See THE ENGINEER, July 30th, 1926.

obtainable, with setting speeds, both forward and return, of 8in. per minute. The total straining movement is 8ft.

On the straining side of the mechanism, a certain amount of frictional loss is allowable, and will not affect the accuracy of the test. The system for measuring the strain, however, must be of a different character, and the load applied must be transmitted to the recording apparatus with the minimum of loss. This end has been achieved by means of an accurately designed system of levers floating on knife edges working within the allowed British Board of Trade tolerances of 5 tons per linear inch on the knife edges. To break down a load of 1,000,000 lb. and to give reasonably fine readings on a steelyard of not too excessive dimensions, entails an accurate lay-out of a system of main and transfer levers. This aim has been realised by transmitting the load through 9 to 1 ratio main levers, coupled at the centre to a suitably proportioned transfer lever, and then through another transfer lever to the steelyard. By combination with a steelyard ratio of 20 to 1 the load is broken down by 20,000 to 1, and readings of 50 lb. on a micrometer dial fitted to the poise propelling screw are easily obtainable. A split poise weighing 50 lb. combined and 40 lb. and 10 lb. separately, is fitted, so that by the use of the small poise finer readings can be made in low capacity tests.

Two notable features of the machine are the autographic recording apparatus and the electrically controlled poise. The second-mentioned detail may be divided into two separate sections, namely, the propelling system and the electrical control system. The drive for the propelling system is taken from the main gear-box through skew gearing to a friction disc drive, which permits the necessary speed variation. From this point to the poise propelling screw, it is transmitted by way of a vertical shaft and gearing. The vertical shaft is fitted with a universal joint, which allows the upper portion freedom to oscillate, and enables a small wheel at its end to make driving contact when required with either side of a grooved friction pulley arranged on a horizontal shaft connected to the poise propelling screw. Electrical control is obtained by means of four contacts arranged in an enclosed box secured to the carrier pillar of the steelyard. One of the contacts is connected with a bell, another with a buzzer, and each of the other two with a magnet. The magnets are arranged on the standard carrying the steelyard fulcrum. Connection is made through the contacts when a plunger carried at the end of the steelyard engages, according to its position, with one of the contacts in the contact box. For example, when the steelyard rises and makes the first contact, a magnet is energised and attracts the lower end of a small lever, which actuates the upper portion of the vertical shaft. This action allows the friction drive to move the poise forward. If the steelyard continues to rise, a second contact is made, which sounds a buzzer and warns the operator to accelerate the poise movement by adjusting the drive to the poise propelling screw. When the steelyard falls, the first contact rings a bell, warning the operator to retard the poise movement, whilst, if the steelyard falls still lower, a second contact energises a magnet to allow the friction drive to move the poise backwards. A system of change-over switches is provided, which permits variation in the sequence of operation.



VARIABLE SPEED MECHANISM

The autographic recorder is situated immediately behind the steelyard, in a position giving good visibility to the operator. The recorder is arranged to enable duplicate records of a test to be taken. The graph paper is secured to a rotatable drum, and the graph is drawn by pens attached to carriages working on a propelling screw. The lateral movement of the pen carriage is in sympathy with the poise and records the test load. The length of the chart may be used to represent various capacities. To permit of the requisite proportional movement of the pen carriage for the purpose of giving full-sized charts at reduced strains, a small gear-box provided with four changes is incorporated in the drive to the screw propelling the recorder pen carriage. To record the elongation of a specimen, the drum is rotated by means of a steel tape carried from the specimen to a pulley on the drum. The details are so arranged that the extension may be shown full size or, if required, magnified 5 to 1 or 10 to 1 by means of spur gearing and pulleys.

Among the smaller details of the machine may be mentioned the hydraulic shock absorbers which, in addition to the usual rubber buffers, are fitted under the platform for taking up the recoil shock; the ball thrust bearings fitted to the worm wheels, for taking the upwards thrust when the load is applied; the oil pump which supplies oil under pressure to the gear-box, straining screw thrust bearings, and other parts; the limit switches for preventing the overrunning of the straining crosshead; and the general lay-out of the controls, all of which are within easy reach of the operator.

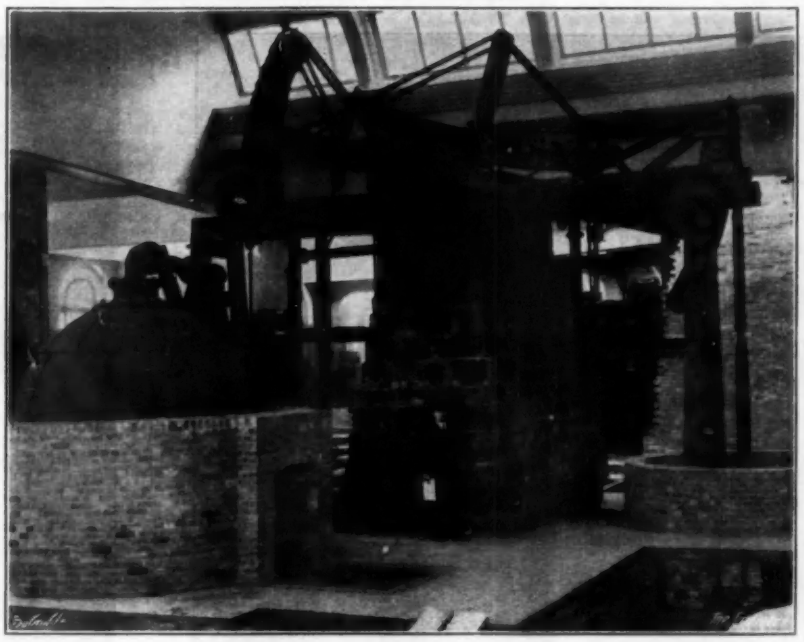
The machine is to be installed with the control box at floor level. The greater part of it will be hidden from view, although all details will be made easy of access. Although the machine is capable of applying the very considerable load of 1,000,000 lb., it will occupy a space of only 18ft. 6in. by 13ft. by 11ft., whilst its height above the floor will be only 12ft.

"Fairbottom Bobs."

THE illustration above represents a Newcomen engine, which until 1928 still stood at Fairbottom, Park Bridge, Ashton-under-Lyne. It is one of the few remaining examples of the atmospheric engine and consists of a cylinder with an open top about 26in. diameter and 6ft. stroke. The steam entered the cylinder at the bottom and condensation was effected by injection of water into the cylinder. There was no condenser. The original beam was of wood braced with iron and had segmental ends, and the piston-rod and pumps were attached to it by chains. The engine had not worked since about 1830. Up to that time it was employed to pump water from a cannel mine some 70 to 80 yards deep and was at one time assisted in this work by a water wheel. Steam for operating the engine was generated in a wagon boiler and the piston was kept tight by pouring upon it periodically a mixture of horse dung and water. The engine is also said to have performed the duty of a scarecrow, for which purpose a cord tied to the centre of the beam was connected with a device known as a "ricker" in the neighbouring cornfield. The nickname of "Fairbottom Bobs" is said to have been suggested by the bobbing up and down of the beam when working.

Mr. Henry Ford was anxious to obtain such an engine for his museum at Dearborn, U.S.A., and the Earl of Stamford kindly presented the relic to him. In 1928 arrangements were made to dismantle the engine and remove it to America. At that time the only parts visible were the cylinder with the piston-rod protruding from the top, the old stone column which had supported the beam, together with certain parts of the ironwork which had braced the beam together, and the complete trunnion blocks in which the beam had rocked. The stone column was composed of large blocks of roughly dressed stone, some of which weighed upwards of 6 cwt. each. These blocks were numbered and taken down after very careful measurements of the relative positions of the cylinder and well had been taken. The cylinder was next removed and then extensive excavations were carried out all round the site. This work resulted in the finding of the complete eduction system and practically all the parts of the valve operating gear, together with several links from the old chain, pump buckets, cast iron pipes, and other parts. With the assistance of old photographs and by comparisons of the recovered parts, the engine was entirely reconstructed. The cylinder was re-bored, the piston repacked and all the original parts were strengthened, either by electric welding or by the electrical deposition of new layers of metal upon them. It was necessary to make a new wooden beam framework and plug rod. These parts were made from selected oak logs completely fashioned by hand and as many of the original iron bracings as possible were used. The engine now stands complete and ready for work, and it is proposed that it shall eventually pump water again from a well which has been specially sunk. Steam will be supplied from a genuine old Haycock boiler which once did duty at one of the collieries belonging to Messrs. Charlesworth, Wakefield. The work of reconstruction and re-erection was carried out in America by Mr. H. Morton, A.M.I. Mech. E., and was supervised by Mr. Ford in person. Mr. Ford insisted that no expense should be spared to make every detail perfect, and so through the interest of this eminent engineer the old Ashton relic will be preserved as a monument of English engineering skill 200 years ago. The engine measures 24ft. between the centres of the piston-rod and pump and 27ft. high from the floor level. The accompanying engraving represents the engine as re-erected in Mr. Ford's museum at Dearborn.

NEWCOMEN ENGINE IN THE DEARBORN MUSEUM



South African Engineering Notes.

To Develop Use of Electricity.

A BIG "drive" to extend the use of electricity throughout the country is being undertaken at the present time, and for this purpose the Electrical Development Association of Southern Africa has been formed. The movement was inaugurated by Dr. H. J. van der Bijl, Chairman of the Electricity Supply Commission, who is President-elect of the new body. The objects of the Association are to develop and encourage the use of electricity in domestic, industrial, agricultural and commercial circles. The Association will give support to electrical engineers and their committees and councils in all approved plans for expansion, and generally will take such steps as will lead to greater service and comfort to the community through the employment of the most modern methods of applying electricity. On the Council of the Association practically all the electrical interests of the country will be directly represented. Already the leading electrical bodies in South Africa have agreed to take a direct interest in the Association. The activities of the new body should do much to popularise electricity. Many people do not use it because they have never been told how to secure its advantages properly. The Association will bring organisation into the use of electricity where, hitherto, incomplete organisation has existed.

First French Congo Railway.

The French Government will have expended nearly 3 million pounds when the only railway in the French Congo, covering a distance of about 380 miles, is finished. It was begun ten years ago, and will take another three or four to complete. The line will link up the new harbour of Pointe Noire on the coast, with Brazzaville, the capital of the French Congo, situated on the Stanley Pool. The construction will give the colony a valuable trade route, which, from Stanley Pool, connects with the rich area of the Congo River basin, with its supplies of the precious wood of Koume. It is necessary, too, for the development of the rich copper deposits near Brazzaville and at Niari at the river basin. Half of the line, which is called the Congo-Ocean Railway, is already constructed from the two ends at Pointe Noire and Brazzaville. The harbour of Pointe Noire on the Atlantic Ocean will be very large when completed. The work is still in progress, but already a line of steamers calls there from Bordeaux. The work began in 1921 with the construction of the harbour, and in 1925 the French Government voted £2,500,000 towards the cost of the railway. As lately as February the French Government authorised the loan of £350,000 for linking up the final stage of the line. Exceptional difficulty has been experienced in building the railway through the Mayombe range of mountains near the coast. It is one of the most difficult and unhealthy regions in Africa. The French employ both native and Chinese labour there.

More Water for the Rand.

A scheme is being prepared to pipe in another 5,000,000 gallons of water per day to the Rand. The Rand Water Board can at present supply 20,000,000 gallons of water a day, of which 10,000,000 gallons come from the Vaal River barrage. It was only in October, 1928, that an extra 5,000,000 gallons per day was piped into the Rand. Water may yet be one of the big problems with which the growing Rand will have to contend.

FOUR-WINDING THREE-PHASE 50-CYCLE TRANSFORMER

ATELIERS DE CONSTRUCTION OERLIKON, SWITZERLAND, ENGINEERS

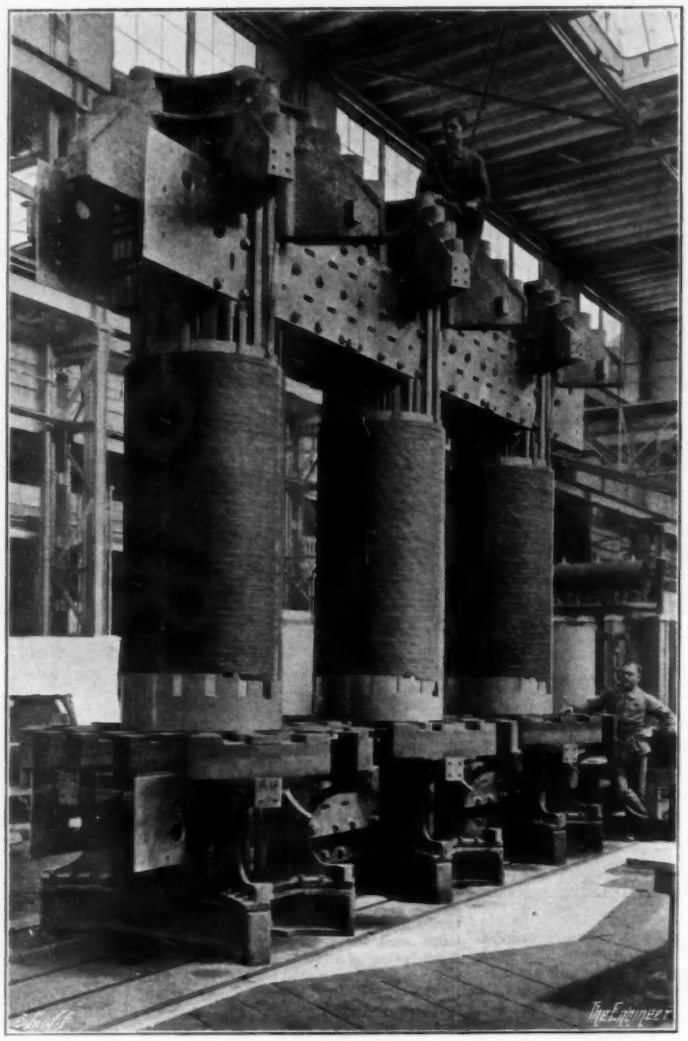


FIG. 1—TRANSFORMER UNDER CONSTRUCTION

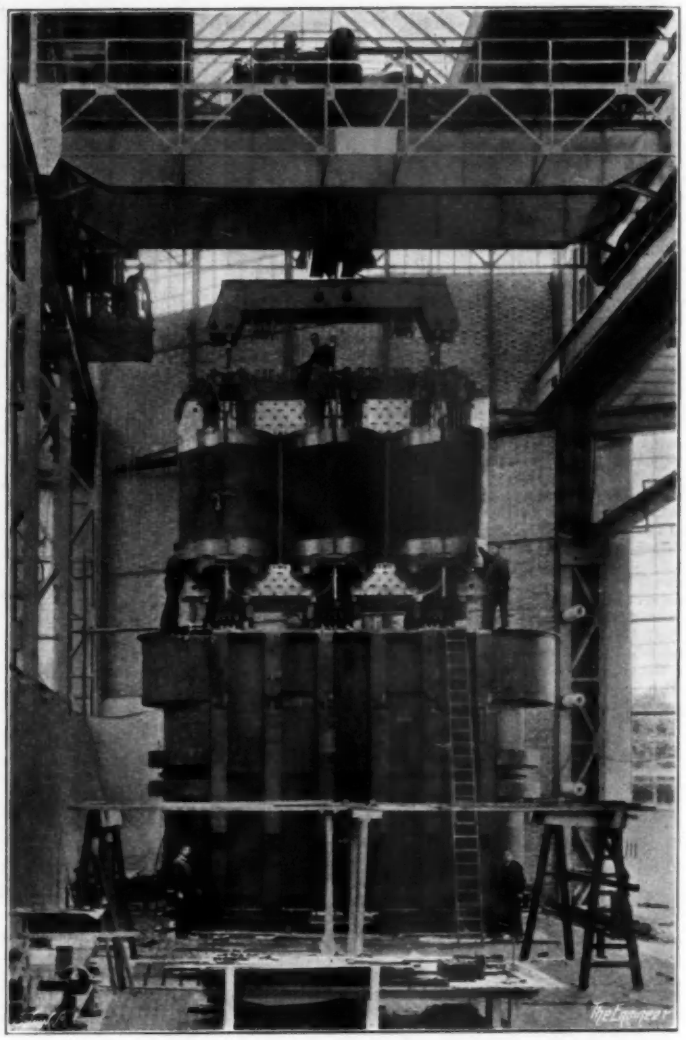


FIG. 2—TRANSFORMER BEING LOWERED INTO CASE

Four-Winding Transformers.

SOME exceptionally interesting three-phase, 50-cycle transformers with four windings have been built by the Oerlikon Company for the Ryburg-Schwörstadt Power Supply Company, Rheinfelden, Switzerland. The capacity of each of the four windings is 32,500 kVA, whilst the continuous overload capacity is 35,000 kVA. The no-load pressure ratios are 10·5 kV/48—116±5 per cent.—145±5 per cent. The 10·5 kV winding is delta connected, whilst the 48-kV, 116-kV, and 145-kV windings are star connected with the insulated neutral brought out of the case. When all the four windings are loaded at the same time each of these transformers can deal with 70,000 kVA.

As will be gathered from Figs. 1 and 2, the transformers are of the core type, the cores having butt joints between the limbs and yokes. The core is built up with paper-insulated laminations, 0·4 mm. thick, and as the maximum length of laminations supplied by continental steel works is 8ft. 6in., the yokes, which are 16ft. 5in. long, had to be made in two parts. The joints have been made away from the centre of the yoke, and the layers of laminations are interleaved, so that the yokes constitute a compact body. Special care was taken to ensure good insulation of the whole of the core, and all parts of the insulation were carefully tested. In order to make the core form a firm and compact body, the parts were pressed together in a large hydraulic press, capable of producing a pressure of 400 tons. The laminations of the limbs and those of the yokes are held together by massive tie-rods and cover plates the latter of non-magnetic material, so as to avoid local heating and additional losses caused by eddy currents.

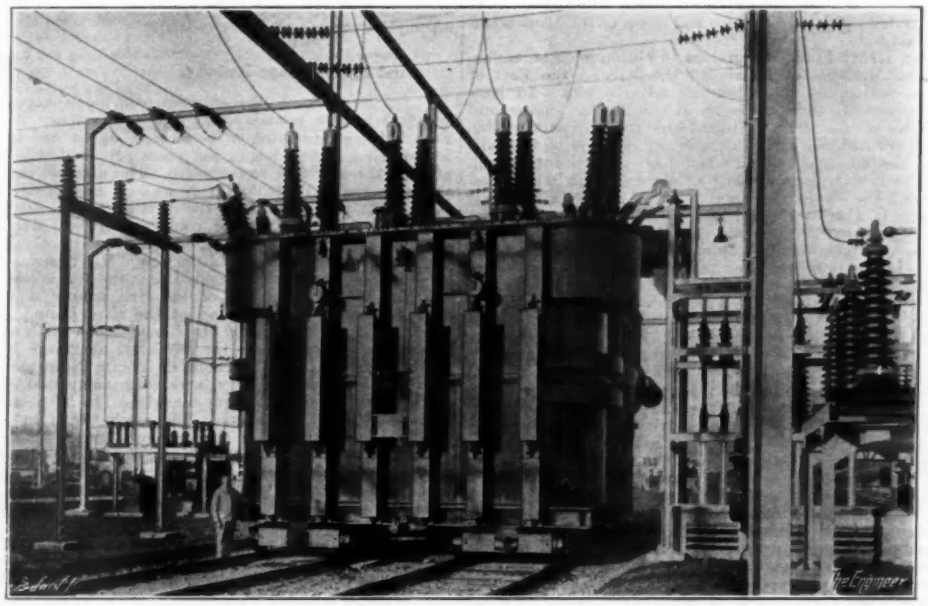


FIG. 3—TRANSFORMER ERECTED ON SITE

As the iron losses can reach 250 kW, there are three cooling slots in each limb, in a perpendicular direction to the lamination layers. In the yokes there are also cooling slots running in a transverse direction to the lamination layers, but as the flux density in the yoke is about 15 per cent. less than in the limbs, these slots are of smaller dimensions.

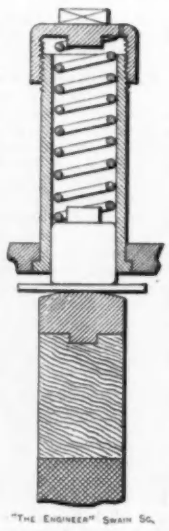


FIG. 4

The two yokes are pressed against the limbs by means of strong tie-rods and cast steel cross pieces, and the pressure is exerted at three points immediately above each of the limbs, thereby ensuring perfect contact between the yokes and limbs and reducing humming and vibration to a minimum. The lower cross pieces are provided with rests, which together with the yoke constitute strong supporting surfaces for the winding. The upper cross pieces are built in the form of frames with radial projections—see Fig. 1—and serve for pressing the windings, the arrangement of which was determined by the specified condition that the ratio between the various short-circuit pressures should not be higher than 1 : 2.

Next to the core there is half the 10·5-kW winding, and following radially the 116-kV, the 48-kV, and the 145-kV winding, and finally the second half of the 10·5-kV winding. To secure the greatest mechanical strength, the coils have been made circular, and both coils of the 10·5-kV winding are wound with one layer. As the copper strip used is only 12 mm. wide, the coils had to be bound in a special manner in order to give them sufficient mechanical strength. The H.T. windings are built up in the usual way in sections, with oil channels between them, and the conductors are insulated with special paper. The insulation has been graded so that for a short time the initial turns can withstand the full terminal pressure—while the other turns with normal insulation can withstand about 60 per cent. of that pressure. At the ends of the 116-kVA and 145-kVA coils there are electro-static pro-

tective rings. Experience has shown, the makers of these transformers state, that transformers insulated on these lines are capable of withstanding pressure surges, and can be connected to an extensive system without H.T. protection.

After the coils were finally assembled they were dried out in an oven, and impregnated with varnish. Ample oil channels and bakelised cylinders ensure adequate insulation between the windings. In the case of the 116-kV winding there are two cylinders on both sides, and three cylinders in the case of the 145-kV winding. The test pressures applied to the 10·5-kV, 48-kV, 116-kV, and 145-kV windings were 57 kV, 104 kV, 269 kV, and 324 kV respectively for one minute. In order that all the five concentric coils on each limb should be subjected to a uniform mechanical pressure in spite of the differences in their design, each coil is pressed individually against the rests on the lower yoke by means of six powerful steel springs, and wrought iron press rings, evenly distributed along the periphery. For the purpose of taking the stress off the springs in the case of heavy axial impacts, due to short circuits, the Oerlikon Company has adopted a special device which is said to have given excellent results for many years under the most severe conditions of service. As shown in Fig. 4, the spring is arranged in a tube, and it presses against the wrought iron press ring and winding, through the intermediary of a piston, the spring being compressed by means of a nut at the top end of the tube. If in the course of time the winding shrinks somewhat, the piston moves a short distance out of the tube, and oil passes into the cylinder through a small hole. In the event of an impact due to a short circuit, which only exerts its greatest force for a very short time, the oil cannot escape rapidly through the small hole and the piston cannot move up. Exhaustive tests are said to have shown that an oil dashpot of this type is very effective, and contributes very materially to the security of the plant against short-circuit stresses. These oil dashpots are built directly into the press frame, and call for no attention. On large transformers, such as those under consideration, it is very important that the winding supports should be properly designed as the transformers can only be overhauled at rare intervals.

The bushings are of the combined oil-filled and condenser type, and the distribution of potential in a radial and axial direction is said to be such that there is no discharge up to the point of flash-over. The test pressures applied to the different bushings under wet conditions were 75 kV, 135 kV, 315 kV, and 375 kV. In all there are fifteen bushings, which are arranged as shown in Fig. 3. The oil tank is built so as to be capable of withstanding vacuum, and for reasons of transport it is made in two parts. It rests on two undercarriages with eight rollers, having a diameter of 1ft. 7in. The illustration, Fig. 3, shows one of the transformers erected on site.

RURAL ELECTRIFICATION ON THE NORTH-EAST COAST.

INTERESTING particulars have just been published by the Newcastle Electric Supply Company concerning the electrification of rural areas in Northumberland, Durham, and the North Riding of Yorkshire. A book by Mr. Holmes Waghorn, on "The North-East Coast Countryside Electrical Development," issued by the company, refers to the early planning of the transmission network, which at the present time is claimed to deal with the largest industrial, domestic, and rural loads of any European power supply company. The length of distribution mains in service in countryside districts is approximately 200 miles, and they are capable of serving a population of some 100,000. During the year 1930 the quantity of electricity supplied from them amounted to nearly 5,600,000 units. In order to promote the sales of electricity a travelling electric show-room has been found to be particularly advantageous in districts in which the density of population would not justify permanent premises. During the eighteen months it has been in commission, the show-room travelled over 350 miles, and visited twenty-seven villages. It was attended by nearly 7000 people, and the activities of the travelling staff are said to have been responsible for an additional connected load of 650 horse-power. The electrification of village houses is being accelerated by the company's arrangements for providing lighting installations and for supplying electrical appliances on the "easy payment" system. Reports are said to show that the adoption of electricity has put comparatively small countryside firms in as good a position as larger firms in towns to carry out work on a competitive basis, and that building contractors have benefited greatly. In a supplement on Distribution, the author refers to the importance of overhead construction. On the average distribution system, about 50 per cent. of the total cost of giving the supplies is shown to be represented by the high-voltage overhead lines. The difference in cost between lines carrying the same size conductors at pressures up to 11 kV is practically negligible, but 20-kV lines are slightly more costly.

THE total imports of machinery and millwork into India during the first three months of this year declined from Rs. 426 lakhs to Rs. 310½ lakhs and the United Kingdom's share from Rs. 330½ lakhs to Rs. 215½ lakhs. This decline in the British share was accounted for by decreased imports of locomotives, electrical machinery, boilers, metal working machinery, rice and flour mill machinery, sewing and knitting machines, cotton textile machinery and jute machinery; while there were increased imports from the United Kingdom of mining machinery and oil crushing and refining machinery. The imports from Germany increased from Rs. 24½ lakhs to Rs. 32 lakhs, due to increased imports of boilers, oil crushing and refining machinery and cotton textile machinery. Imports from the United States totalled Rs. 44 lakhs, as against Rs. 50¼ lakhs in the previous year. There was a slight increase in the imports from Belgium from Rs. 4 lakhs to Rs. 4¼ lakhs, while those from Japan remained stationary at Rs. 1½ lakhs.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Returning Confidence.

THE oppressive uncertainty of the past few weeks has now been lifted, and with faith in the future stability of the nation, confidence is returning to Midland and Staffordshire industrial circles. True, trade currents still run slowly, and as yet there is a marked absence of the customary autumn buying movement, but the way has been cleared for progress, and it is firmly believed that it will come. Already inquiries are more numerous in several branches of trade, and although the economies entailed in the balancing of the Budget may involve interference with trade in some directions, the clarifying of the situation and the outlook should result in a release of business recently in suspense, and in a general desire to put British industry again upon its feet. The demand for iron and steel this week has been subdued, but the market tone in Birmingham shows considerable improvement.

Pig Iron.

Midland blast-furnacemen are becoming increasingly hopeful of the future. Customers in this area are showing more interest in the market, and inquiries are growing in number and relate to slightly larger tonnages than has been the case of late. A few foundrymen who have been off the market for some time are reported to have this week placed small contracts. This move towards buying ahead is all to the good, and should it develop will be much appreciated by Derbyshire and Northamptonshire blast-furnacemen. So far, this month smelters report that business is in advance of that of last month, but it is recognised that some of it may be accounted for by the fact that in the normal course of events orders now being given out would have been placed in August. Stocks of iron at the furnaces in Northamptonshire are heavy, and production continues in excess of market requirements. Selling prices of Midland irons are unchanged, Northamptonshire No. 3 foundry being £3 2s. 6d. and Derbyshire and North Staffordshire £3 6s., delivered to stations in the Black Country and subject to rebate. Forge grades are 5s. per ton less in each case.

Staffordshire Bar Iron.

Makers of bar iron in Staffordshire remain much under-employed, business generally being sluggish. Few ironmasters anticipate any real improvement in trade in the immediate future, for there are no signs yet of the quickening of demand which normally sets in in the autumn. They are glad that the Government's intentions are now, partly at any rate, known, for the recent atmosphere of uncertainty having lifted, there is place for one of confidence. This is greatly needed, for there is said to be much business held in suspense. There is no change in market conditions on the week, demand varying in the different departments as it has done for many months past. Values, too, are quotably unchanged. Marked bar prices are firmly held, Crown bars are selling more and more at figures nearer the minimum than the maximum quotation, while common bars cannot hope to increase their value when continental material, used for similar purposes, is procurable at the present low rates. Business is bad in the tube strip department, and some makers have reduced their quotation half a crown per ton to £10 10s. This figure is not acceptable to all producers in this district. It is felt that this low price is only a temporary measure to enable mills to carry on, and that the quotation will be withdrawn as soon as works order books present a better appearance.

Steel.

In the steel department there are no movements worthy of comment. Business is dull in practically all branches of the finished and semi-finished trades. Demand for structural steel is confined to small tonnages for early delivery, and producing works carry on mostly on a hand-to-mouth basis as an alternative to closing down. Half-products are difficult to sell against continental steel. Increased inquiries for the latter are said to have been received this week by Birmingham merchants. Belgian and French producers are quoting billets at as low as £3 18s. 6d. delivered, small bars at £4 6s. 6d., and strip at £5.

Steel Scrap.

The steel scrap market is practically lifeless. Birmingham merchants have difficulty in persuading works to take delivery of material against contracts. Most of the works have substantial stocks, but if scrap is wanted inquiries are broadcast by the buyer to find the lowest possible price. Any attempt to quote a price for steel scrap would be misleading in the present state of trade. Bargaining is the rule when supplies are needed.

Galvanised Sheets.

Buying of galvanised sheets on overseas account has improved somewhat, but local mills require a considerably larger volume of business on their books before they can claim to be able to see far ahead or to make regular full-time production. The orders at present in hand relate in many cases to the needs of the West Indies and South America. The Eastern market continues dull. Millowners are anxious for business, and values consequently continue to recede. While some producers quote 24 gauge galvanised corrugated sheets at as high as £9 5s. per ton f.o.b., others ask as low as £8 17s. 6d. Tonnages continue light, and buyers are under the impression that further price concessions could be had if large orders were available. Black sheets sell fairly well, but demand is below the level at this time last year. Values in this department are unaltered.

Trade Returns.

The trade returns for the month of August are depressing. Imports and exports were lower in value than for many years past. Imports at £65,261,000 were £14,592,000 less than in the corresponding month last year, and exports were £13,640,000 down on last year's figures at £29,137,000. What Midland industrialists particularly do not like is the fact that of the £13,640,000 decline in exports no less than £11,150,225 came under the head of manufactured goods, and the further fact that every group in this classification showed a decrease.

Manufacturers Want Tariffs.

The Midland Council of the National Union of Manufacturers, while on Monday offering its support to the Government in its financial policy, called upon it to place an immediate duty on imports. It considers that it is impossible for this country to re-achieve a satisfactory balance of trade without Protection. Simultaneously, the Manchester Chamber of Commerce declared the restriction of imports to be an urgent, imperative necessity. So widespread is the impression that tariffs must be imposed—and the sooner the better for British industry—that a number of further resolutions urging the Government to take action will be passed and forwarded to the proper quarter in the course of the next few weeks.

"Made in Birmingham."

Birmingham manufacturers are being urged to enter upon a world-wide publicity campaign not only with the object of making known the city's products, but also to banish the idea that "made in Birmingham" applies only to trashy wares and meretricious articles. It is urged that Birmingham should become not a byword applied to the cheap imitations of native products, but respected because of the known and undisputed quality of the wide range of scientifically manufactured goods of sound quality and practical utility for which it was justly renowned.

Birmingham Company's Development.

It is reported in Midland industrial circles that the John Wright and Eagle Range Company, Ltd., gas apparatus manufacturers, of Thimble Mill-lane, Birmingham, has absorbed the biggest concern of gas-fitting makers in New Zealand, namely, the Brinsley Company of Dunedin.

Unemployment.

Unemployment in the Midlands area has declined on the week by 12,627, the total now standing at 401,892. There are 270,792 wholly unemployed in the division, 130,488 temporarily stopped, and 612 normally in casual employment. The total is higher by 109,344 than in the corresponding week last year. The improvement ranges over the following areas:—Birmingham, Coventry, Cradley Heath, Dudley, Leicester, Stoke-on-Trent, Stourbridge and Brierley Hill, and Wolverhampton. Many of the Black Country towns associated with the iron and steel and heavy engineering industries are in a worse position than a week ago.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinery at Low-water Mark.

SHIPMENTS of textile machinery during August made much the worst showing for any month during recent years, and prospects in both the home and export branches of this important Lancashire engineering industry are the reverse of cheerful. During the period under review, the total shipments amounted only to 3309 tons, valued at £344,000, compared with 7468 tons and £692,457 in August, 1930. Of last month's total, 2304 tons and £250,106 represented spinning and twisting machinery, and 597 tons and £53,747 weaving machinery. All markets have been seriously affected, but especially British India, which, however, still leads the way with takings valued at £103,394. Japan is a very poor second, with £22,219, followed by France £21,330, Germany £16,971, China £16,226, the Netherlands £14,483, the United States £14,425, South America £10,551, Australia £8452, and Russia £2214. Aggregate shipments to "other European countries" were valued at £84,423, compared with £128,676 in August, 1930. The extent of the decline in the overseas demand for British textile machinery will more readily be gauged from the fact that in the completed eight months of the present year exports have amounted in value only to £3,426,691, against £6,364,954 in the January-August period of 1930.

Transport Economies.

Several North-country engineering concerns were among the contributors to an assembly of high-compression oil engines at the Hyde-road workshops of the Manchester Corporation Transport Department, arranged in connection with a Conference of the Managers' Section of the Municipal Tramways and Transport Association, held here on Thursday and Friday of last week. The firms whose products were demonstrated included Crossley Brothers, Ltd., Leyland Motors, Ltd., the Associated Equipment Company, Ltd., Blackstone and Co., Ltd., John I. Thornycroft and Co., Ltd., Norris, Henty and Gardner, Ltd., and T.S. Motors, Ltd. The delegates were also keenly interested in a demonstration of the "regenerative" type of tramcar, which was the subject of a paper delivered by Mr. G. H. Fletcher, chief engineer and manager of the Sheffield Works of the Metropolitan-Vickers Electrical Company, Ltd. It is understood that experiments on the Manchester system under ordinary conditions of service have shown a saving of about 15 per

cent. through the adoption of the regenerative braking apparatus.

The Haweswater Scheme.

A report gained wide currency in Manchester early this week that the Manchester Corporation Waterworks Committee had under consideration, on the ground that, in consequence of the industrial depression, the demand for water had fallen off appreciably and that the question of providing for additional supplies was now of less urgency, the postponement indefinitely of the Haweswater scheme, the cost of which is estimated at from £10,000,000 to £11,000,000. The report, however, was quickly modified. Mr. Holme Lewis, the engineer-in-charge of the Haweswater scheme, stated that already the authorised works had been so far advanced that the Waterworks Committee, even in the interests of economy, could not afford to delay their completion. The scheme is divided into two main portions. Work on the first half, which has been in progress for about a year, is expected to take five years altogether. There appears to be some likelihood, however, that, for economic reasons, certain portions of the work authorised may be held up for the time being, and this question the Committee is expected to consider at a meeting later this month.

Smaller Demand for Locomotives.

The annual report of the directors of Nasmyth, Wilson and Co., Ltd., locomotive, hydraulic and general engineers and ironfounders, of Patricroft, Manchester, states that the number of orders for locomotives received in the past year was 72 per cent. less than the average for the past thirty-five years, and that the reduced demand has resulted in increased competition. A loss of £11,255 was sustained on the year's trading, compared with a profit of £13,145 in 1929 and one of £18,402 in 1928. The ordinary shareholders received a dividend of 5 per cent. for 1929, but no distribution is to be made in connection with last year's operations. The preference shareholders, however, are to be paid the usual dividend of 8 per cent., tax free. The directors of British Insulated Cables, Ltd., of Prescot and Helsby, have declared the customary interim dividend of 5 per cent. on the ordinary share capital.

Into Retirement.

Constructed by Messrs. Todd, Kitson and Laird, of Leeds, nearly a hundred years ago—in 1838 to be exact—the locomotive "Lion," which started its career on the Liverpool and Manchester Railway, was handed over by the Liverpool Engineering Society on Tuesday of this week to the London, Midland and Scottish Railway Company for permanent exhibition at Lime-street Station, Liverpool. Its career as a locomotive lasted about twenty years, and from 1859 until 1928 it was employed by the Mersey Docks and Harbour Board at the Prince's Dock as a pumping engine. In 1928 it was given into the care of the Liverpool Engineering Society, and last year, before taking an active part in the Liverpool and Manchester Railway centenary celebrations, it entered the Crewe shops of the London, Midland and Scottish Company for a process of rejuvenation.

Non-ferrous Metals.

Movements on the non-ferrous metals markets during the past week have not been inspiring, for there have been losses in all sections, with copper the principal sufferer. For the time being, tin has belied the hopes of speculators, who, with more or less confidence, were inclined to look for a steadily rising market when the Pool's scheme was outlined some weeks ago. The "bullish" influence of this seems to have been exhausted for the present, and following upon last week's heavy loss, there has been a further decline on balance of about 15s. a ton, current values being below those ruling a month ago. The demand for copper continues on a very restricted scale, and no remedy seems yet in sight for the unwieldy statistical position. Far from the bottom of the market having previously been touched, a loss of slightly more than £2 on the week has brought prices of standard brands to decidedly new low "records." There has been a moderate movement of lead, but in this case, also, values have again lost ground, current rates being lower by about 5s. a ton. Spelter is half-a-crown cheaper on balance, and the demand for this metal during the past week has been on a restricted scale.

Iron and Steel.

In view of the generally unsettled conditions iron and steel users on this market seem to have adopted an intensified policy of marking time, so far as new commitments are concerned. Orders for almost all classes of material have been pronouncedly scarce during the past week, and in both iron and steel the tonnage bought has been very disappointing. Foundry iron makers sold moderate quantities for delivery over September about three weeks ago, and there has been only a restricted movement since. Quotations keep up, however, with Staffordshire, Derbyshire and Cleveland makes at 67s. per ton, Northamptonshire at 65s. 6d., Scottish at about 86s., and West Coast hematite at 81s., all for delivery equal to Manchester. The bar iron trade continues quiet, with Lancashire Crown quality material maintained at £9 15s. per ton, and No. 2 at about £8 5s. In both home-produced and imported steels, the demand from almost all directions has been of a retail character, and there is little immediate hope of better things, improvement in most of the Lancashire consuming industries being, apparently, as far off as ever. There has been little in the way of steel price changes to record since last week.

BARROW-IN-FURNESS.

Hematite.

In common with the rest of the iron-producing districts, the North-West continues to feel the slump. In cases where there is restriction of output, the stocks are gradually being reduced, but buyers are still hesitant about ordering a single ton above their immediate requirements. The American business is now down to very little. The Continent is still a customer, but the shipments recently have not been heavy. There was a cargo for Antwerp last week and, in addition, a part cargo was shipped from Barrow for Japan. The iron ore trade is very quiet; in fact, it is a long time since there was such a poor demand for either native or foreign ores. Apart from the local business in native ores, the outside demand is slight. The steel market is in a poor way. Workington will be engaged on railway material for a while, the contract being part of a South African order. There is a moderate trade in hoops and special small sections. Steam coal and East Coast coke are in quiet demand, especially the latter.

SHEFFIELD.

(From our own Correspondent.)

The General Position.

ALTHOUGH the feeling of increased confidence in the future still exists, there is little or no improvement to be noticed in the local trade situation at present. In one or two cases, the production of open-hearth steel has been increased, but the ordinary demand for this material for general commercial purposes is as poor as ever. At the great works of the United Steel Companies, the number of furnaces in operation remains at seven. There is, however, very poor employment at the mills, and both orders and inquiries alike still relate to moderate quantities, and lack that substantial bulk which is required to indicate any revival. At the wire rod mills, short time is general. The trade in cold rolled steel and strip, which for some years was very active, has fallen away considerably of late, and is not, at present, of more than half the normal volume. The depression in special lines of manufacture is much less acute than in ordinary branches, but even here there are few departments which are not more or less affected. That the demand for some of the alloy steels is still declining is suggested by the quiet state of the ferro-alloy market. The consumption of tungsten has, in fact, fallen to the lowest level known for many years, and the output of high-speed steel, in which that material is a principal ingredient, has declined very seriously. While Sheffield tool steel retains its high reputation, and is preferred by many continental engineers, high tariffs make it an expensive luxury in these days of financial stringency, and exports are consequently on a poor scale. There is still a moderate demand for this steel, and also for tools, from engineers at home. The use of tools in which only the tip is of expensive high-speed steel is constantly expanding, and this no doubt has something to do with the lessened volume of trade, but it is a prevailing opinion that the present position is due chiefly to poverty of consumption.

Some Works Details.

At the works of Hadfields, Ltd., one of the greatest in the city, one of the two large foundries has been closed, and activity concentrated at the other. A number of men have been discharged in consequence. The second plant has, however, been made very busy, and the firm is, as a matter of fact, busier just now than it has been for some time. It has increased its output of open-hearth steel. John Baker and Bessemer, Ltd., of Rotherham, have also restarted an idle furnace. The firm is largely engaged in railway work, and has on hand some good export orders for tires. The railway plants generally continue extremely short of work, alike in axles, tires, and springs. Hopes with regard to work for China, in connection with the Boxer Indemnity Fund, have so far not materialised at all. It is still expected that some good orders will come to the city for springs and buffers, but there is a probability of the axles and tires being made in Manchester. The United Steel Companies have booked an order for 35,000 steel sleepers for China, but they will be rolled at the Workington establishment. The order will not call for any considerable weight of steel, and will be executed quickly. It is also reported that the United Steel Companies are among the firms—together with the Cargo Fleet Iron Company, Middlesbrough, and the Lancashire Steel Corporation, Warrington—concerned in a contract for 9500 tons of steel rails which has been given out by the South African Railway Board. Arthur Lee and Sons are enlarging and improving a wire rod mill, which will result in a substantial increase of capacity.

Steel Economising.

Sheffield industry inaugurated its policy of economy long before the Government took the matter up nationally, and the process is still going on. Great efforts are being made to concentrate work and eliminate unnecessary labour. Salaries and wages have been reduced in all directions, and there are now many unemployed departmental managers, foremen, and clerks. The latest instance of the use of the economy axe to be reported is at the Vickers works of the English Steel Corporation. The salaries of directors and officials, above £200 per annum, are to be reduced, as from November 1st, by percentages varying from 5 to 10—the first £200 being exempt from cut—while the directors' fees are to be halved.

Stainless Steel.

This branch of trade, which includes not only ordinary stainless steel, but the newer materials designed for resisting heat and corrosion, continues to be one of the bright spots in local industry. The demand for most classes of these steels is well sustained. Two of the leading firms of makers—Thos. Firth and John Brown, Ltd., and Brown Bayley's Steel Works, Ltd.—have interesting exhibits at the Shipping, Engineering and Machinery Exhibition at Olympia, and have received a number of inquiries from representatives of home, foreign, and Dominion firms, which are expected to produce good orders. A special feature of Messrs. Firth-Brown's display is an outboard motor boat, made entirely of Staybrite steel. These boats only weigh 1¾ cwt. each, and can easily be lifted by two men. They will be used principally in the East, in places such as the Federated Malay States, where the water has a high acid content.

Two New Trades.

Sheffield continues to look out for new branches of industry, and there is at present evidence of the success of its enterprise in this direction. About a year ago, as I reported at the time, an English firm dealing in vacuum cleaners stated that, although it then had its goods made in the United States, it was prepared to give its work to a Sheffield firm if it could find one to undertake it. Sheffield Steel Products immediately got interested in the matter, made inquiries, and secured a large contract, which is now in course of execution. The firm opened a new department for the work, equipped it with entirely new plant, and engaged the workpeople from the employment exchange. Another new industry, about to be started in the city is the making of cinema seats of tubular steel, either chromium or stainless. Several feet of tubing are required for each seat, so that the industry has before it a prospect of much success. Two Sheffield men, Messrs. K. Friese-Green and Frank Nicholson, are the inventors of the seats.

Iron Roads.

There is hope for one of the trades carried on in this district, if not exactly in Sheffield, in the growing interest that is being taken in iron roads. The Stanton Ironworks Company, Ltd., a leading Derbyshire firm, has an experimental section of iron road at its works, which for ten months has borne very heavy traffic without any sign of wear. Now an experimental iron road is to be constructed at Worcester from plates supplied by the Stanton Company. The Worcester City Council has inspected some of the plates, which are triangular in shape, of heavy section, and are studded all over the face with a rectangular pattern like the non-skid tread of a motor tyre.

Company Reports.

A satisfactory year's result is reported by the Staveley Coal and Iron Company, Ltd. The profits, after providing for management expenses and taxation, and including dividends from subsidiary and other companies, amount to £432,074, as compared with £408,167 in the previous year. The dividend is again 6 per cent. tax free, and the carry forward is increased from £99,135 to £107,143. The Sheffield Forge and Rolling Mills Company, Ltd., has unfortunately a story of a very different kind to tell. It has made a number of losses during recent years, but last year it was on the wrong side by only the comparatively small sum of £2581, and in 1929 it made a profit of £2177. For the year ending June 30th last, however, it has to report a loss of no less than £17,245, bringing its debit balance up to a total of £80,529. The Neepsend Steel and Tool Corporation made a profit of £25,795, and paid a dividend of 9 per cent. At the annual meeting, however, the chairman spoke of present conditions as being extremely bad, and said that he doubted if the company was working at a profit at the moment.

Cutlery and Plate.

There is little to say about the cutlery and plate trades except that the general quietude continues. Few of the old-established houses are working at a profit, and those which can cover expenses and avoid loss are considered fortunate. The question of rationalisation or concentration in the trade has been under discussion for some time, and, although nothing has resulted yet, it is still engaging the attention of people of influence. A few makers of safety razor blades are fairly busy, and have good prospects, but the trade generally is quiet. Lines to retail at 1d. are being produced by one or two new firms which have come into the trade. The present quietude is partly due to the issue of a warning that the new type of blade to fit the latest Gillette holder is patented. Several local firms have been producing these blades in considerable quantities, but, in order to avoid the risk of legal proceedings, some of them have suspended the operation.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Outlook.

THE restoration of confidence in industrial circles in the North of England can only be gradual at the most, but it is significant that already a more hopeful atmosphere permeates the markets, particularly for iron and steel. This is, no doubt, inspired by the revival of the talk of a protective tariff. Continental competition still continues keen, and comparatively cheap overseas products are still sold to firms which were at one time among the best customers of this district. Business in pig iron has definitely begun to expand. The makers report that stocks of foundry iron are being reduced and are now about 10,000 tons below the figure recorded at the beginning of the year. There is, of course, little likelihood of any increase of production, but the withdrawals from stock constitute a favourable sign.

Cleveland Iron Trade.

As already indicated, business in the Cleveland pig iron trade is steadily improving. Transactions are chiefly for early delivery, but some little expansion of inquiry on forward account is encouraging. Export trade shows hardly any improvement, and dealers in overseas iron continue to retain Scottish trade, though Cleveland iron is offered to firms beyond the Tweed at exceptionally low prices. Cleveland quotations are steady and unchanged, No. 1 foundry being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

The embarrassing statistical state of the East Coast hematite pig iron trade shows no sign of improve-

ment. Stocks are heavy and increasing, and the limited output will have to be further curtailed shortly by more furnaces ceasing to operate. It is difficult to ascertain the lowest terms on which orders might be accepted, but sellers are keen to secure contracts on the basis of ordinary qualities at 60s., but business is stated to have been put through at less.

Ironmaking Materials.

The foreign ore trade is more or less idle, and 14s. 6d. c.i.f. Tees is a purely nominal sellers' quotation for best Rubio ore Blast-furnace coke is plentiful and in very quiet demand. Sellers still base market rates on good average qualities at 15s. delivered at the works.

Manufactured Iron and Steel.

Manufactured iron and steel prices are not quotably changed. In nearly all branches orders are urgently needed, but sections producing constructional steel keep well employed, and a few contracts for railway material have been arranged.

Ironworks Closed Down.

The Ayresome Ironworks of Gjers, Mills and Co., Ltd., Middlesbrough, which were only reopened in May after being idle several months, are being closed down again this week owing to lack of orders. Two blast-furnaces, which have been engaged on the production of hematite, are being blown out. When the works were restarted in May it was known that the move was taken on the strength of a number of orders which had been received and which, though they might not have justified the reopening of the works, inspired the firm to hope that further orders might follow. The continued bad state of trade, however, has had its effect, and it has been found impossible to keep the works open. Several hundred men will be thrown idle.

The Coal Trade.

Few new features are noticeable in the Northern coal trade position. Most of the best brands of coal are well booked to the end of the month. Forward, there is a much brighter outlook. Several large orders are circulating, and merchants hope to be able to secure a substantial portion of them. With a very moderate surplus of large Northumberland steam coals to be disposed of for this month, holders are asking firmer prices. Supplies are limited to odd parcels, up to 13s. 9d. being obtainable. For next month supplies are offered more freely, but a number of inquiries are in the market for shipment of supplies over the last quarter of the year. Sellers are not so keen to commit themselves to the minimum, but fear of continental competition prevents any pronounced hardening in values. Best Northumberland steams for the remainder of the year are quoted at 13s. 6d. Durham prime steams, which give signs of improvement over the next month or two, are also quoted steadily for large at 15s. Tyne primes are scarce for prompt and firmly quoted at 12s. 9d. to 13s., but forward 12s. 9d. is readily indicated. In Northumberland there are great stocks of small steam coals, with few signs of a better demand. The Durham gas coal trade continues very disappointing, and the trend of the next few weeks does not indicate any revival of activity. Best qualities are quoted at 14s. 6d., and prime Wears at 15s., with the undertone easy to the end of the year. Secondary gas coals are neglected at 13s. 6d., but best Durham bunkers are well taken up for prompt and quoted steadily at 13s. 6d. to 13s. 9d. Secondary bunkers, also coking unscreened, are plentiful at 13s. 3d. to 13s. 6d. There is a continued quiet demand for blast-furnace coke on home account, and in the export section the inquiry is no better and supplies are offered freely. Present production of gas coke is steadily absorbed, but the trade is not sufficient to reduce stock appreciably.

SCOTLAND.

(From our own Correspondent.)

Heavy-oil Engines.

IT is of interest to learn that Fiat British Auxiliaries, Ltd., with works at Govan, has been reconstituted and renamed British Auxiliaries, Ltd. The reconstituted company has entered into a manufacturing agreement with the Atlas-Diesel Company, Ltd., Stockholm, in order that British Auxiliaries, Ltd., will be in a position to offer both British-built "Polar-Atlas" and "Fiat" types of engines for marine and land installation. A large number of heavy-oil engines for various auxiliary purposes have been manufactured at Govan during the past four years, and recent orders include British-built "Polar-Atlas" engines to be fitted to ships in Glasgow.

Limited Markets.

The amount of business in the markets for steel, iron and coal is still very limited. Home demands have a certain measure of regularity, but export is most spasmodic. The various industries, on the whole, are devoid of new engagements of importance, and have little encouragement to anticipate an early departure from the present hand-to-mouth system of buying. With the autumn season there may be a slight movement towards an improvement in overseas trade, but so far there has been little sign of such development.

Steel.

In the steel trade it is estimated that only about 35 per cent. of the plant capacity is in operation. Orders for heavy steel are most disappointing, specifications from shipyards especially being below expectations. Sheet-makers have experienced a brisk demand for the Japanese market, and light sheets were busier for a short period, but business is quieter again. Buying for the Indian and Chinese markets is conspicuously absent. Steel tubes are very slow, but the amount of inquiry is fairly good. Scrap materials are cheaper with cast iron machinery at 46s. and heavy steel at 37s. 6d. per ton. Steel prices, on the whole, are unchanged, but it has been reported that galvanised corrugated sheets of 24 gauge have been quoted at £9 2s. 6d. for export, and that a figure under £9 per ton has been done.

Iron.

Makers of bar iron and re-rolled steel bars have a very poor outlet, and the production is severely cut. Bar iron is unchanged at £10 5s. home and £9 10s. per ton export, but a trifle less than £6 per ton purchases re-rolled steel bars.

Pig Iron.

The Scottish pig iron trade continues without relief. Quantities of material still arrive in the district, a consignment of 1200 tons having been discharged last week. Total exports amounted to 572 tons, 315 tons of which went to foreign ports. Scottish makers have agreed to a reduction of 1s. 6d. per ton, and hematite is now quoted 68s. 6d., delivered to steel works, No. 1 foundry 72s., and No. 3 foundry 69s. 6d. per ton f.o.t. makers' works. In Scotland only one furnace remains in action.

Coal.

No outstanding change has taken place in the Scottish coal trade during the past week. Foreign demands are not improving, the inquiry being restricted and mostly for very moderate quantities for prompt or early shipment. West of Scotland splints have a fairly regular outlet and third-class Fife steams move off comparatively well; but other descriptions of round coal are fairly easily obtained at recent prices. Industrial requirements are far below normal. Gas and electricity concerns are increasing their deliveries as the autumn advances, and household fuels are in better demand. Collieries have little difficulty in securing the 1s. 6d. per ton advance on household coal, which was announced at the beginning of September. Aggregate shipments amounted to 248,793 tons, against 199,066 tons in the preceding week, and 213,525 tons in the same week last year. Tenders have been despatched for the supply of 40,000 tons of Lanarkshire coal for the purposes of the Swedish State Railways, but exporters are not hopeful of securing any of this business.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

ONE week is now very much like another, so far as the steam coal trade of this district is concerned. The inquiry does not appear to get out of the rut of months past, but keeps quiet and uninteresting. At the moment there is no tender business on the market which specially concerns this area. It is true that the Danish State Railways have asked for prices for about 160,000 tons of coal for October to March delivery, but it is probable that only about 16,000 tons will be Welsh coals. With the current demand from abroad displaying no expansion, it is inevitable that the conditions should be somewhat depressing. Shipments vary slightly from week to week, but there is no sign of any permanent increase. The figures of the Great Western Railway with respect to coal and coke for last week showed an improvement upon the preceding week of 53,790 tons, the total shipments being 437,960 tons, but when they are compared with the corresponding period of last year there is not far short of 100,000 tons to be made up, as the quantity then was 524,006 tons. Up to date this year the aggregate of coal and coke shipments comes to 15,207,700 tons, whereas for the same period of 1930 the total was 19,950,566 tons—a formidable deficit of nearly 4¾ million tons. Reference was made last week to the reductions which had been made in the minimum prices for superior large steam coals. So far, this action has had no perceptible effect upon business in these coals, but perhaps it is as yet early to look for it. The market is not by any means optimistic that these reductions will result in an increased amount of business. As the leading coals are more closely graded, the possibility is that the orders which do come along will be more evenly distributed among the various qualities, instead of being placed for the cheaper descriptions, as invariably happens when times are bad.

Freight Rates.

Reference was made last week to the serious position of shipowners in view of the extremely low freight rates prevailing. Since then there has been no improvement; on the contrary, even lower rates have been conceded for the Mediterranean. For instance, Alexandria has been fixed at 5s. 9d., and a steamer has been chartered in Genoa to load coals at Cardiff for that port at the low figure of 5s. 3d. We have to go as far back as twenty-five years ago to find rates of freight to compare with these figures. Rates for practically all directions, including the River Plate and Rio de Janeiro, are to-day well below the averages for 1910, yet, as pointed out, the running costs of shipowners are nowadays 50 to 60 per cent. above what they were in pre-war years. Steamers are laid up at all the ports, and it is safe to say that a good percentage of this tonnage will never run again.

Trade and Tariffs.

The works of P. Baker and Co., iron and steel and metal merchants, of East Moors, Cardiff, are being dismantled, consequent upon the long spell of trade depression. The firm was established in 1884. A good deal of comment and discussion has been occasioned in local trading circles by the statements published in the leading local daily newspaper from nearly a dozen prominent coalowners, shipowners, labour representatives, and others who have been Free Traders all their lives, but have now changed their views and favour the imposition of tariffs in one form or another in order to regain our former industrial position.

North Wales Audit.

The audit of the North Wales coalfield for the three months ended July reveals a loss of £8670, which is equivalent to 2·65d. per ton, which compares with a loss of just over £3000, or under 1d. per ton, in the three months ended June. The proceeds per ton in July were 12s. 8·57d., as against 12s. 9·09d. in June, while costs of production were practically the same in the two months, viz., 12s. 11·07d. per ton in July and 12s. 11·65d. in June. The economic wage certified was 99·48 per cent. of the basis rates, but the district agreement provides for a minimum wage representing 22 per cent. above the basis rates, and the payment of the minimum percentage left a deficiency of £76,076. The deficiency carried forward has thus been increased to £4,212,816.

Current Business.

Operations in steam coals have been extremely quiet, and with the exception of some of the lower volatile coals, prices have displayed no real steadiness and remain at the minima. Small coals, especially, have been excessive and banking continues, there being no outlet for these descriptions. Sized qualities are also not at all as busy as might be expected at this time of the year. Large coals vary considerably, and some of the Monmouthshire descriptions are not now so well engaged, owing to the Italian State Railways cutting down their shipments. It is stated that since the end of August they have only taken about half their usual quantity. This week did not open at all favourably from the point of view of the collieries, as the report from the Great Western Railway Company was that on Monday there were twenty-nine idle tipping appliances at the various docks, and recent chartering cannot by any means be described as having been active. Patent fuel is quieter in demand, and there is not a very satisfactory outlet for coke. Pitwood supplies are more plentiful and prices are easier.

LAUNCHES AND TRIAL TRIPS.

MANVANTARA, twin-screw motor tank ship; built by the Netherland Shipbuilding Company, to the order of the Royal Shell Group; dimensions, 467ft. by 61ft. by 34ft.; to carry oil in bulk and general cargo. Engines, oil, of Werkspoor type; constructed by the builders; launch, August 22nd.

PAN EUROPE, motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of A/S Abaco, Oslo; dimensions, 483ft. by 65½ft. by 37ft. 3in.; to carry oil in bulk. Engines, oil, Wallsend-Sulzer type; constructed by the Wallsend Slipway and Engineering Company, Ltd.; trial trip, August 26th.

CARDITA, twin-screw motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Anglo-Saxon Petroleum Company, Ltd., London; dimensions, 450ft. by 62ft. by 34ft.; to carry oil in bulk. Oil engines of Hawthorn-Werkspoor type; constructed by R. and W. Hawthorn, Leslie and Co., Ltd.; trial trips, September 1st and 2nd.

REAEL, steamship; built by Netherland Shipbuilding Company, Ltd., to the order of the Koninklijke Paketvaart-Maatschappij; dimensions, 311ft. 3in. by 46ft. 6in. by 28ft. 11in.; to carry passengers and cargo. Engines, "Lentz;" constructed by Messrs. N. V. Machinefabriek Gebrs. Stork and Co.; trial trip, September 2nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE TRAILER APPLIANCE COMPANY has opened offices at 44, Pall Mall, London, S.W. 1, to handle the Neate adjustable trailer brake control.

THE INDIA RUBBER, GUTTA PERCHA AND TELEGRAPH WORKS COMPANY, Ltd., desires us to say that the address of its London branch is now Aldwych House, Aldwych, London, W.C. 2.

VICKERS-ARMSTRONGS, Ltd., requests us to say that the manufacture of the Vickers Pyramid hardness testing machine is being transferred to the company's works at Crayford, Kent.

MR. J. F. I. THOMAS, O.B.E., M. Inst. C.E., M.I. Mech. E., until recently with the Vickers, Ltd., group, has been elected to to the board of British Jeffrey-Diamond, Ltd., Wakefield, as co-managing director.

B. AND S. MASSEY, Ltd., of Openshaw, Manchester, have appointed as their London and district representative as from September 1st, 1931, Mr. G. M. Turnbull, M.I. Mar. E., Baltic House, Leadenhall-street, London, E.C. 3.

BURN SILENT GEARS, Ltd., a newly formed company, of Caxton House, Westminster, London, S.W. 1, has taken over the British rights of the Silent Burn Gear, including those previously held by Stothert and Pitt, Ltd., of Bath, and Burn Transmissions, Ltd.

MATTERSON, Ltd., machine tool makers and manufacturing engineers, of Healey Works, Shawclough, Rochdale, informs us that Mr. W. J. Arterton, of 3, Lime-avenue, Albert Promenade, Loughborough, has been appointed agent for the whole of its specialities for the counties of Leicestershire, Northamptonshire, and Lincolnshire, and Mr. J. C. Campbell, 58, Sandford Grove-road, Nether Edge, Sheffield, has been appointed agent for the counties of Derbyshire, Nottinghamshire, and the West Riding of Yorkshire.

AKTIEBOLAGET ATLAS DIESEL, Stockholm, has granted a manufacturing licence for "Polar" two-cycle airless injection engines to British Auxiliaries, Ltd., of Helen-street, Govan, Glasgow. This company, previously known as the Fiat British Auxiliaries, Ltd., of the same address, has now been reconstructed. The chairman of the company is Sir Fredk. Lewis, Bart., and seats on the board are held by Mr. C. J. Cowan, Viscount Glenapp, Mr. E. W. Harvey, Mr. I. P. R. Napier, M.C., and Mr. J. H. Silley, O.B.E. British Auxiliaries, Ltd., will manufacture at their Govan works "British Polar" engines of all the various types and sizes. The sale of these "British Polar" engines will be solely handled by the Atlas Diesel Company, New Oxford House, Hart-street, W.C. 1.

THE MACHINE TOOL EXHIBITION.—At a recent general meeting of members it was decided that the Machine Tool Trades Association will not be holding an exhibition until 1934.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	14/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 0 0	3 0 0
No. 1	3 0 6	3 0 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*), 4 0 6 (*b*), 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	10 12 6	9 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boilcr)	8 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	4 17 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	8 17 6 to 9 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	12/9 to 13/-
Block Tin (cash)	113 5 0
„ (three months)	116 5 0
Copper (cash)	29 5 0
„ (three months)	30 0 0
Spanish Lead (cash)	10 12 6
„ „ (three months)	10 18 9
Spelter (cash)	10 18 9
„ (three months)	11 8 9
MANCHESTER—	
Copper, Best Selected Ingots	34 0 0
„ Electrolytic	35 0 0
„ Strong Sheets	62 0 0
„ Tubes (Basis Price), lb.	0 0 9½
Brass Tubes (Basis Price), lb.	0 0 8½
„ Condenser, lb.	0 0 11
Lead, English	12 2 6
„ Foreign	10 17 6
Spelter	11 5 0
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£20 12 6	7/-
„ „ 8 p.c. to 10 p.c.	£19 17 6	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£30 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£35 15 0	13/-
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	8/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/3
„ „ Splint	14/- to 15/9
„ „ Trebles	12/6 to 13/-
„ „ Doubles	12/- to 12/6
„ „ Singles	10/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	13/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 12/-
Screened Navigation	17/-
Trebles	13/6 to 14/6
Doubles	12/6 to 12/9
Singles	10/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	10/9 to 11/-
Secondary Steam	10/- to 10/6
Trebles	13/- to 13/6
Doubles	13/-
Singles	10/-

(8) N.W. COAST— ENGLAND.

Steams	20/-
Household	30/- to 51/-
Coke	20/- to 30/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/-
Steam Smalls	7/6 to 8/-
Unscreened	12/6 to 13/-
Household	27/- to 30/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.
Best Hand-picked Branch	24/6 to 25/6 —
South Yorkshire Best	23/6 to 24/6 —
Derbyshire Best Bright House	21/- to 22/- —
Best House Coal	21/6 to 22/6 —
Screened House Coal	19/- to 20/- —
Best Screened Nuts	18/- to 19/- —
Small Screened Nuts	16/6 to 17/6 —
Yorkshire Hards	17/- to 18/6 —
Derbyshire Hards	17/- to 18/6 —
Rough Slacks	9/6 to 10/6 —
Nutty Slacks	7/6 to 8/6 —
Smalls	5/6 to 6/6 —
Blast-furnace Coke (Inland)	10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/- to 15/-	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6
Second Smokeless Large	18/9 to 19/6
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/-
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	19/- to 19/9
Pitwood (ex ship)	25/6 to 26/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 23/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Motor Fuels.

At the early meetings of the Congress on national motor fuels the various kinds of liquid and solid fuels available at home and in the colonies were reported upon and discussed, and last week a further meeting was held at the Colonial Exhibition to deal with the methods of adapting motor car engines and chassis to those fuels. The use of coal gas suggested changes in lorry design for the accommodation of compressed gas bottles, and gas engineers see in the commercial vehicle a vast opening for the consumption of gas that will provide a solution of the coal problem. They have failed to convince others, because the matter is purely one of economy, and producers have not been able to supply gas at a price that will compensate for the dead load of the storage bottles and the limited range within which lorries can travel from the sources of supply. That range is approximately 30 miles. For years past gas companies have been running vehicles on this fuel, and in Paris two omnibuses have been in service on gas; but there is no evidence that coal gas can compete with other fuels until the price is appreciably reduced. The Congress decided that the only practical way to demonstrate the economy of coke oven and coal gas for traction purposes was for coal owners and gas companies to run local services of vehicles within their respective areas. Coal gas finds a serious competitor in suction gas. The types of suction producers recently introduced are lighter than storage bottles, and while the fuel cost is very much less, the vehicles running on suction gas are not limited in their range of action. The suction gas plant on lorries failed to secure sustained interest for some years because the equipment was not suitably adapted to the lorry, through lack of experience; but that experience has now been acquired, and makers of producers have evolved new ideas, and even new principles, whereby they eliminate the troubles and the cost of upkeep that appeared to be almost inseparable from the old lorry suction gas plants. At the same time, new methods of preparing wood fuel for suction gas have been introduced, and there is plenty of evidence that suction gas for road traction has entered upon a new stage of technical development. During the past week military trials have been carried out with eight or nine different types of suction gas lorries. Another point dealt with at the Congress was the necessity of designing motor car engines to run on different fuels. French engineers have always aimed, and are still aiming, at getting the maximum power out of the smallest cylinder volume, and they continue to increase the piston velocity. There are commercial and economic drawbacks to this practice. In particular, it prevents the utilisation of fuels other than petrol, because larger volumes are required for the same power. Therefore, some engine builders, who believe that the future lies in employing various kinds of home fuels, are increasing the cylinder dimensions with the idea of giving a rated power with fuels of lower heat value and obtaining the same power with a smaller consumption of petrol. Various carburetting devices have been introduced for using different fuels. This return to slower-running engines of larger cylinder volume is impeded by the motor tax, which is based on the volume. The Congress decided that this obstacle must be removed, one suggestion being that the tax should be imposed on the fuel so that the user could employ it in any way he pleased.

Harbour Works.

Like other ports, Saint-Malo has carried out extensive works with a view especially to developing traffic with Southampton, and recently a direct service was inaugurated between Southampton and the Pyrenees. When, however, the harbour works were completed it was found that more had to be done to render the port easy of access in all weathers. There are strong currents which affect even the harbour itself, and in high winds cargo boats with light loads and ships with high freeboard run a risk when approaching the lock inside the harbour. Work at some of the ports has been practically suspended since the national equipment scheme was deprived of German aid, and the Chambers of Commerce are obliged to finance the undertakings themselves. The Minister of Public Works has now authorised the Saint-Malo Chamber of Commerce to continue its programme. At present the lock is approached by a channel 80 m. wide, which is wholly insufficient, and this will have to be widened from 250 m. outside the harbour to 100 m. near the lock gates. Protection against currents and heavy seas will be provided by an extension of the existing mole and the construction of a new one.

Pneumatic-tired Rail Coach.

An experimental run was made last week with a pneumatic-tired rail coach between Paris and Deauville, when the passengers included Monsieur Dautry, General Manager of the State Railways, and several prominent railway engineers. The vehicle was a 45 horse-power, six-wheeled lorry chassis, with transmission to the central axle and fitted with a duralumin coach body. The total weight, with passengers and luggage, was 4200 kilos. Unofficial figures of the run show too many discrepancies to be accepted. It is declared that the average speed on the return journey exceeded 60 miles an hour, and that the experiment demonstrated the possibility of reaching higher speeds with more powerful engines and stream-line bodies. Orders for coaches with pneumatic tires have been placed by the State, Est and Midi railway companies.

Engineering.

Amongst wagon builders work is scarce now that the railway companies have suspended buying, and in the various engineering departments there is less activity, except where manufacturers are engaged on State contracts. The work of national defence and the construction of State oil depôts are providing some employment. The Compagnie des Bateaux à Vapeur du Nord has placed an order in England for two boats of 5500 tons, because they can be supplied more quickly and more cheaply than in France.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

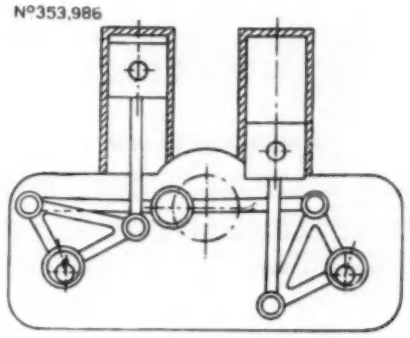
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

353,986. May 27th, 1930.—A VARIABLE COMPRESSION ENGINE, H. Kundig, 10, Allées des Sciences, Boudy Coquetier, France.

The inventor proposes to vary the compression ratio of an internal combustion engine to suit the load while it is running. In the illustration we reproduce there is shown a two-cylinder

N°353,986

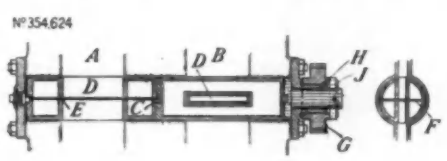


engine with one crank. The connecting-rods are attached to bell cranks, which in turn are connected with the crank. The bell cranks are mounted on excentric pivots. By turning these pivots the relative position of the piston in the cylinder can be altered and the compression ratio consequently varied. Means are indicated for automatically effecting this change.—*August 6th*, 1931.

354,624. October 21st, 1930.—ROTARY VALVES, J. Thorkildsen, Sandnespr, Stavanger, Norway.

The object of this invention is to provide a rotary valve which will keep tight regardless of variations of temperature. The inlet port is shown at A and the exhaust at B. The valve is made in two pieces connected together by the dovetail C. Each piece is pierced with a port D for the passage of the gases. It is

N°354,624



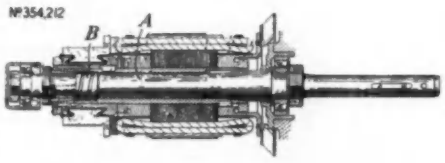
also slit, as shown at E. In this slot there is placed a plate of resilient material F, which is pierced to correspond with the port. It is presumably intended to bear against the casing and make a tight joint. The driving sprocket G is mounted on a fixed bush H and drives the valve through the cotter J, so that no bending stress is put on the valve.—*August 13th*, 1931.

DYNAMOS AND MOTORS.

354,212. May 3rd, 1930.—DYNAMO-ELECTRIC MACHINES, J. Stone and Co., Ltd., of Deptford, Kent; and Alfred Edward Honey, of No. 31, Seymour-gardens, Ilford, Essex.

In the case of train lighting dynamos it is of importance to be able to withdraw the armature spindle and to mount a fresh armature on the old spindle, or insert a fresh spindle in the old armature without loss of time or the exercise of particular skill. According to the invention, the laminated armature is assembled upon a sleeve A which is removably mounted on the armature spindle by the aid of centring cones on the latter. One of the cones, which is fixed, may be an integral formation on the spindle, whilst the other, which is axially adjustable and contractable thereon, may take the form of a split collet applied

N°354,212



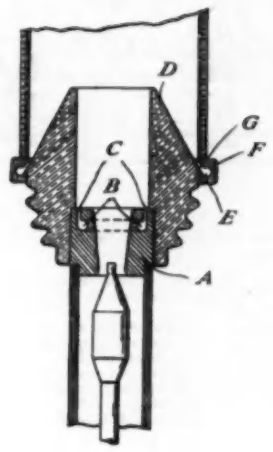
between the spindle and a hollow conical end of the sleeve. The adjustable cone is forced into its tightened position against the resistance of a strong spring B interposed between it and the sleeve and adapted for transmitting to the sleeve a considerable end thrust for tightening the sleeve against the fixed cone. By this means the tightening of the one end of the sleeve upon the fixed cone must be completely effected before the adjustable cone is finally forced home at the opposite end for wedging that end tightly upon the spindle. It will be seen that by this means the sleeve is accurately centred and tightly secured upon the spindle by the cones at the two ends, the intermediate length of the sleeve being clear of the spindle, so that the latter suffers no damage or deterioration due to the mounting of the armature parts.—*August 4th*, 1931.

SWITCHGEAR.

355,133. November 15th, 1930.—GAS-BLAST ELECTRIC CIRCUIT BREAKERS, *International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.*

In gas-blast electric circuit breakers difficulties have been experienced in preventing the insulator from being coated with metal or metal oxides which arise from the heating of the switch contacts when an arc is formed. The object of this invention is to provide an arrangement which will substantially eliminate this disadvantage. The stationary contact A has a ring-shaped passage B, out of which gas flows through the openings C and extends along the inner surface of the insulator

N°355,133



D. A ring-shaped passage E may also be provided on the outer holder F, out of which pressure gas flows through the openings G over the outer surface of the insulator D. Gas is arranged to be supplied to the passages simultaneously with the actuating of the switch, in such a way that at the moment of interruption gas flows over the surface of the insulator D.—*August 20th*, 1931.

BATTERIES AND ACCUMULATORS.

354,318. May 7th, 1930.—POSITIVE PLATES FOR ELECTRICAL STORAGE BATTERIES, Sidney James Williams, of 9a, Stratford-road, Kensington.

This specification describes a positive plate for electrical storage batteries, in which a block composed solely of active material is interposed between metal grids arranged so as to provide a large exposed surface external to the block. The plate is constructed by casting metal, *i.e.*, lead, around the block A of active material, formed, for example, of red lead. The edges of the block A are enclosed by a rim B, while the faces of the block are enclosed by the grids C, the bars of which are preferably of wedge or triangular section, as shown. The bars of the grids are formed so as to provide a large exposed surface external to the block A of active material. In the case of a

N°354,318

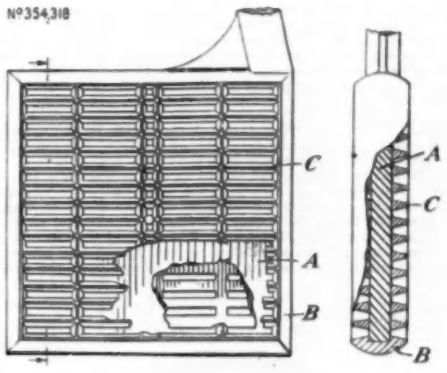


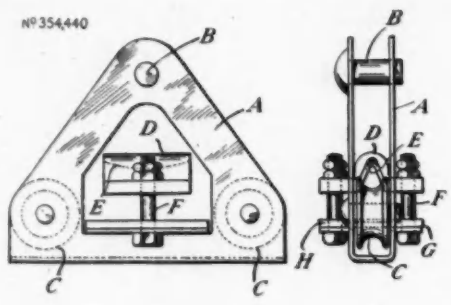
plate 4in. square constructed as shown, a grid surface in the neighbourhood of 72 square inches may be obtained, with a block of active material one quarter of an inch thick and with grid bars of one quarter of 1in. deep on each side of the block. A plate formed as described may be charged at a rate about 200 per cent. higher than the usual charging rate, and may be discharged by short circuiting with a copper bar, without distortion, disintegration of or damage to the plate. After the plate has been "formed," brown peroxide of lead is deposited on the inclined surfaces of the grids, and this deposit gradually increases in depth during the subsequent use of the battery. This deposit forms active material and progressively increases the capacity and efficiency of the battery the longer the battery is in use, the block of active material A then acting more or less as a reservoir.—*August 7th*, 1931.

TRANSMISSION OF POWER.

354,440. May 28th, 1930.—SUSPENSION CLAMPS FOR ELECTRIC POWER TRANSMISSION LINES, Thomas John Kinsey and John Leslie Gaved, both of Bird-street, Lichfield.

As ordinarily constructed, the inventors state, the suspension clamps for transmission lines are such that considerable time and labour are entailed in pulling and fixing the cable in a taut condition, and it is the object of the invention to facilitate the work. The new suspension clamp comprises a bracket A which is preferably U-shaped in side elevation. The upper end is provided with a pin B, by means of which it is fixed to an insulator. The bottom of the bracket carries a pulley C at each end, the pulleys being grooved for receiving and supporting the cable which passes through the bracket and over the top of the pulleys. Means are provided for clamping or gripping the cable between the pulleys and conveniently comprise a clamping plate D having a V-shaped groove E. The clamping plate is fixed in position by means of the bolts F which pass through the sides of the clamping plate and the lugs G on the bracket. When the clamping plate D is pulled down on the cable the cable is curved downwardly between the pulleys. The cross sectional shape of the groove E is such that the pull on the cable automatically wedges the cable in the groove, which is also curved longitudinally so that the curved portion of the cable will bind along or substantially along the full length of the groove. The lugs G also carry the plate H on which the cable may be pressed to fix the cable more securely in the groove E. Any number of

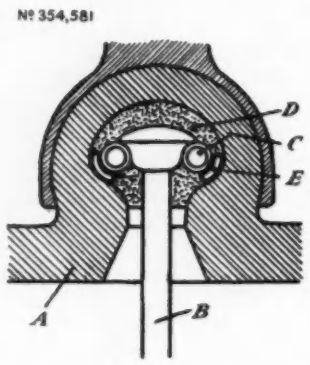
bolts F may be used. In the case of an end fitting, the end of the cable after passing over both the pulleys may be carried back



under the bracket and fixed to the main length of the cable.—*August 13th*, 1931.

354,581. September 2nd, 1930.—ELECTRIC INSULATORS, Johannes Wilhelm Hofmänn, of Kotzschenbroda, near Dresden, Germany.

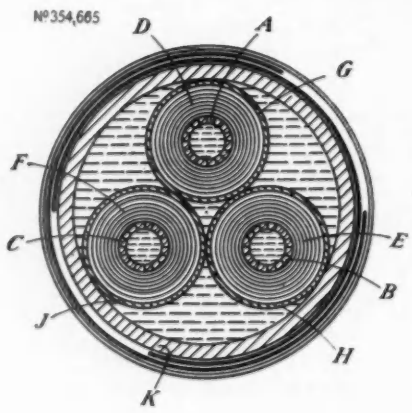
The metal fittings of chain insulators are connected at present to the insulating body without any stopping or cement. As a rule the insulating body is made of porcelain. Experience shows, however, that insulating bodies can never be manufactured so accurately as to ensure completely smooth or flat surfaces. In accordance with the invention, a soft metal plate is formed into a shell in which is embedded a yielding or elastic inter-



mediate layer. The yielding or elastic intermediate layer follows the uneven shape of the insulating body and brings about a uniform distribution of pressure. The intermediate layer is made, for instance, from asbestos, paper, fibrous material or lead. In the drawing A indicates the insulating body, B the insulator rod or stud, C the metal parts which prevent the stud from slipping out, D the material for casting or filling. The yielding or elastic intermediate layer mounted in metal and forming the subject matter of the invention is shown at E.—*August 13th*, 1931.

354,665. December 16th, 1930.—MULTICORE HIGH-TENSION ELECTRIC CABLES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

Oil-filled cables constructed according to this invention afford the advantage that upon sheathing the individual cores the loss of oil from the insulation is only slight and can easily be made good from the hollow conductor. A further substantial advantage consists in the fact that leakages of the lead sheaths of the cores are perfectly harmless because the spaces are entirely filled with oil, and oil cannot therefore escape from the indi-

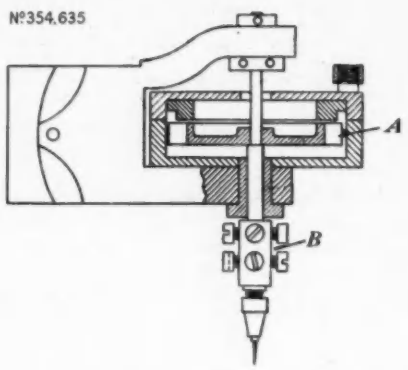


vidual cores. In the drawing, A, B and C are the three hollow conductors of a high-tension cable; D E F show the paper insulation wound upon the conductors, which is impregnated with oil, whilst the interior of the hollow conductors is also filled with oil. G H J are the thin lead sheaths pressed upon the insulation D, E and F of the conductors. K is the lead sheath common to the three cable cores, which is provided with an iron band armouring. The intermediate spaces between the lead sheath K and the three cores and the intermediate space between the three conductors are filled with oil in the same way as the cores themselves.—*August 13th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

354,635. October 31st, 1930.—HIGH-SPEED DRILLS, Deutsche Gold-und Silber-Scheideanstalt vormals Roessler, 7/9, Weissfrauenstrasse, Frankfurt-am-Main, Germany; and K. Bromig, 1, Domitianstrasse, Frankfurt-am-Main.

The principal claim in this specification is for:—A high-speed precision drilling machine, particularly for the clock industry, characterised in that the drill spindle is directly connected to the shaft of a motor having a very high speed of rotation, particularly of a turbine driven by water, compressed air or steam, and the drill chuck is secured to the drill spindle by a centring bush, for example, one having eight set screws, so that the smallest deviations in the rotation of the drill can be compensated. The

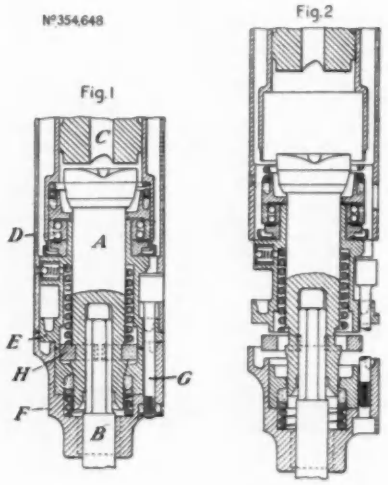


turbine, which is said to run at 20,000 revolutions per minute or more, is shown at A. The eight-screw centring bush is marked B.—*August 13th*, 1931.

MINING MACHINERY.

354,648. November 10th, 1930.—ROCK DRILLS, Aktiebolaget Nordiska Armatur-fabrikerna, Regeringsgatan 61, Stockholm, Sweden.

This rock drill is operated by an electric motor, but the invention is concerned only with the means used for securing the anvil in which the drill is held. The anvil is shown at A, the drill at B, and the striker at C. The casing is made in three separate parts

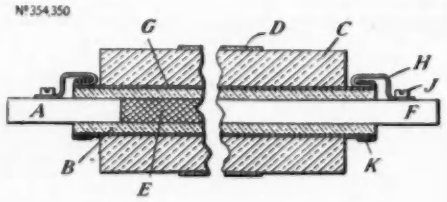


D, E and F, held together by the bolts G. A groove is cut in the anvil, and into this is slipped the split ring H, which prevents the anvil from dropping out. When it is desired to dismantle the drill the bolts G are slackened off and turned so that their hooked ends are released from the casing part D. The three parts can then be separated to expose the working parts, while the split ring can be removed to release the anvil as shown in Fig. 2.—*August 13th*, 1931.

MISCELLANEOUS.

354,350. May 2nd, 1930.—INSULATION OF ELECTRICAL CONDUCTORS, Kenneth Graeme Maxwell, of "Lasswade," St. Margarets-road, Bowden, Chester; Percy Gilman Ashley, of "Glendevon," Raglan-road, Stretford, Manchester; and Associated Electrical Industries, Ltd., of Bush House, Aldwych, Westminster.

This invention relates to the insulation of electrical conductors and in particular to insulation of the kind commonly known as varnish paper bushings or insulation, in which a conductor is provided with a number of layers of varnish-treated insulating material. With conductors insulated in this manner it is desirable that a slipping surface should be provided in order to avoid difficulties from differential expansion of the conductor and the insulation covering as a whole and movements due to



creepage, the effects of which are usually cumulative and sometimes prove very troublesome. Referring to the drawing, A is a metal conductor which is covered with layers of insulation, of which the innermost layer or layers are indicated at B and other layers at C, an earth band being shown at D. A portion E of the conductor is knurled or otherwise roughened so that the surrounding insulation will be anchored thereto. The remaining portion indicated at F is provided with a slipping surface so that the conductor may move axially relatively to the insulation. Where it is desired to prevent the innermost layers of insulation indicated at B from being subjected to electric stress a metal layer G is provided, which is connected to the conductor A by means of a flexible conducting connection H secured to the conductor A by means of a screw J and to the metal layer by means of a wire wrapping, as indicated at K.—*August 4th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

FARADAY SOCIETY.—In the Rooms of the Chemical Society, W. 1. "The Passivity of Metals," by Professor W. J. Müller, of Vienna. 5.30 p.m.

INSTITUTE OF METALS.—Autumn meeting at Zürich. For programme, see page 21.

TO-DAY TO SUNDAY, SEPTEMBER 20TH.

NATIONAL SMOKE ABATEMENT SOCIETY.—Annual Conference at Liverpool. For programme, see page 220.

TO-DAY TO MONDAY, SEPTEMBER 21ST.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—At Lady Margaret Hall, Oxford. Eighth annual conference. Friday evening, presidential address, by Professor A. M. Carr Saunders. For programme see page 265.

TO-DAY TO SATURDAY, SEPTEMBER 26TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia, W. Daily, 11 a.m. to 9 p.m.

TO-DAY TO SUNDAY, SEPTEMBER 27TH.

INTERNATIONAL FOUNDRY EXHIBITION.—Milan.

MONDAY, SEPTEMBER 21ST.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Midland Institute, Paradise-street, Birmingham. "Faraday" Commemorative meeting. 7.45 p.m.

WEDNESDAY, SEPTEMBER 23RD.

INSTITUTE OF FUEL.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, W. 1. Discussion, "The Reactivity of Coke: A Report to the Blast Furnace Committee, Iron and Steel Industrial Research Council," by Mr. J. C. King and Mr. J. H. Jones. 6 p.m.

WEDNESDAY TO FRIDAY, SEPTEMBER 23RD TO 25TH.

INSTITUTION OF MINING ENGINEERS.—Manchester. Postponed summer general meeting.

FRIDAY, SEPTEMBER 25TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W. Ball. 9 p.m. to 2 a.m.

TUESDAY TO FRIDAY, SEPTEMBER 29TH TO OCTOBER 2ND.

IRON AND STEEL INSTITUTE.—Autumn Meeting at Swansea. For programme see pages 105 and 255.

FRIDAY, OCTOBER 2ND.

INSTITUTION OF CHEMICAL ENGINEERS.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Gas Generator as a Direct Producer of Metallurgical Products," by Messrs. N. E. Rambush and F. F. Rixon. 6 p.m.

WEDNESDAY, OCTOBER 7TH.

DIESEL ENGINE USERS ASSOCIATION.—In the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Joint Meeting. "Coal, Smokeless Fuel and Oil from the National Standpoint," by Dr. W. R. Ormandy. 7 p.m.

FRIDAY, OCTOBER 9TH.

INSTITUTION OF PRODUCTION ENGINEERS.—Council Room of the Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Annual General Meeting. 7.30 p.m.

THURSDAY, OCTOBER 15TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Annual Dinner.

FRIDAY, OCTOBER 16TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster. Special General Meeting. By-laws. 6 p.m.

FRIDAY, OCTOBER 23RD.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster. Presidential Address by Lt.-Col. Kitson Clark. 6 p.m.

SELF-TAPPING SHEET METAL SCREWS.—The Parker-Kalon Corporation of New York, U.S.A., has developed two new types of hardened screw which appear to have some outstanding advantages for making fastenings to sheet metal and for other assembly work. They are being marketed in this country by Buck and Hickman, of Whitechapel-road, London. These new screws are not driven in with a hammer, as in the original type of screw, but they are turned into position with a screw-driver, cutting their own thread as they penetrate the metal. The threads are somewhat like those of the ordinary wood screw, and they enable the screws to be turned into metal such as brass, steel, iron, aluminium, and die castings, &c., just as a wood screw is turned into wood, without stripping or otherwise injuring their own hardened thread or the thread they make in the material. The fastenings that result from their use are said to remain secure under intense vibration and the most severe service conditions.

A NEW ALUMINIUM ALLOY.—A new light alloy, designated M.V."C," has been produced by the Metropolitan-Vickers Electrical Company. It is a pure alloy of aluminium and silicon, prepared by a new process which has been patented by the company. It combines the qualities of strength and ductility, together with excellent resistance to corrosion and good working characteristics, both for casting and for subsequent operations. Aluminium-silicon alloys if melted and cast without special treatment are weak and brittle. The new process of "modification"—as it is called—consists in adding a reagent to the metal in its molten state, and the effect is to produce a fine-grained close-knit micro-structure, with a marked improvement in strength, ductility, and other properties. Results of the modification can be seen by micro-examination of the eutectic structure and by the character of the tensile test fracture, which exhibits a silky rather than a crystalline appearance. Above all, however, it is shown by the properties of strength and ductility. The ultimate tensile strength of M.V."C" alloy is given as 9 to 11 tons per square inch when sand cast, and 11 to 13 tons per square inch when chill cast. The ductility of the metal, even when cold, is so great that castings can be "set" or bent to a considerable extent without risk of damage. The ductility of the alloy is also shown by the fact that it can be rolled, drawn, spun, forged, pressed or stamped, even into quite thin sections. The material so worked is greatly improved in strength and ductility. The Metropolitan-Vickers Electrical Company has for a considerable time used this alloy exclusively for light castings required in its own manufacture, but has now extended its production to supply M.V."C" alloy to users in other industries in the form of castings, rolled sheet, drawn rods, tubes, spinnings, pressings, or stampings.